APPENDIX 6
ENGINEERING SUMMARY

YAZOO BACKWATER AREA REFORMULATION

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YAZOO BACKWATER AREA REFORMULATION

APPENDIX 6
ENGINEERING SUMMARY

SECTION 1 -GENERAL

AUTHORIZATION

PROJECT AUTHORIZATION

1. The Yazoo Basin Reformulation Study is an evaluation of the remaining unconstructed feature of the authorized Federal flood control project for the Yazoo Basin. The Reformulation Study is divided into four major features of concern and includes a thorough analysis of engineering, economic, and environmental aspects of project alternatives. Report project features in the Basin include (1) Upper Steele Bayou Project, (2) Upper Yazoo Projects (UYP), (3) Yazoo Backwater Project, and (4) Headwater Tributaries Project. Reports for project features (1) and (2) were completed in 1992 and 1993, respectively. This Engineering Summary discusses and documents the findings of Feature 3--Yazoo Backwater Project. The Headwater Tributaries Project is an ongoing study.

REPORT AUTHORITY

2. The Flood Control Act (FCA) of 1941, dated 18 August 1941 (House Document (HD)/359/77/1), as amended by FCA's of 22 December 1944 and 27 October 1965 (HD/308/88/2), and the Water Resources Development Act of 1986, authorized the Yazoo

Backwater Project. The FCA of 1941 provided for the extension of a levee along the west bank of the Yazoo River from the Mississippi River levee to Yazoo City, Mississippi. Also included in the authorized plan of 1941 was a structure at Little Sunflower River and a combination structure and pumping plant at Big Sunflower River, Deer Creek, and Steele Bayou with a total pumping capacity of 14,000 cubic feet per second (cfs).

3. The FCA's of 1944 and 1965 extended the project to include approximately 38 miles of levee on the east bank of the Yazoo River and features for fish and wildlife.

PURPOSE OF REPORT

4. The purpose of this Engineering Summary is to document results of the best formulated plan and its baseline cost estimate for a comprehensive flood control project feature for the Yazoo Backwater Project. This flood control feature will protect a large agricultural area and many small communities in the lower Yazoo Delta from backwater flooding.

PRIOR STUDIES, REPORTS, AND EXISTING WATER PROJECTS

PRIOR STUDIES AND REPORTS

5. Previous reports and studies that are pertinent to the Yazoo Backwater Project are listed below:

a. Big Sunflower, Little Sunflower, Hushpuckena, and Quiver Rivers, and their Tributaries, and Deer Creek, Steele Bayou, and Bogue Phalia, Mississippi, General Design Memorandum (GDM) No. 1, September 1955. This report proposed a system of channel improvement along these area rivers and tributaries.

b. Annex M to the Mississippi River and Tributaries, Comprehensive Review Report, Big Sunflower River Basin, 16 November 1959. This report recommended that the scope of the existing authorized project for the Big Sunflower River Basin be increased to provide greater channel capacity on Steele Bayou and its tributaries.

c. Big Sunflower, Little Sunflower, Hushpuckena, and Quiver Rivers, and their Tributaries, and Deer Creek, Steele Bayou, and Bogue Phalia, Mississippi, Supplement A (to GDM No. 1), April 1962. This report recommended modifications to project streams as proposed in GDM No. 1.

d. Supplement B (to GDM No. 1), October 1963. Prompted by local interests, this report modified GDM No. 1 to add channel improvement to a reach of Quiver River.

e. Steele Bayou, Main Canal - Riverside Drainage District (Canal No. 9) and Black Bayou, Supplement C (to GDM No. 1), February 1964. This supplement recommended more extensive improvement on Steele Bayou, Main Canal, and Black Bayou than those proposed in GDM No. 1 and modified in Annex M.

f. Muddy Bayou Report (Eagle Lake), December 1969, was prepared in response to requests by the Warren County Board of Supervisors, the Mississippi Game and Fish Commission, and other local interests. As a result of the report, the Yazoo Backwater Project

was modified to include the Muddy Bayou Control Structure. The water control structure, approved and completed in 1970 and 1977, respectively, allows manipulation of lake levels between Eagle Lake and Steele Bayou for improvement of water quality and fishery resources in the lake. The structure also provides incidental flood protection for properties along Eagle Lake.

g. Yazoo Basin, Yazoo Backwater Area, Fish and Wildlife Mitigation Plan Report, July 1976, and approved by the Chief of Engineers on 3 December 1976, authorized construction of nine greentree reservoirs and nine slough control structures in the Delta National Forest. These features as proposed would mitigate the fish and wildlife losses caused by the Yazoo Backwater Project. Four greentree reservoirs and five slough control structures have been completed. The others were eliminated due to unsuitable site conditions and problems with existing easement.

h. Steele Bayou Basin, Plan Formulation, GDM No. 18, August 1976. This report recommended modifying the authorized project to provide additional channel improvements on Steele Bayou and Black Bayou.

i. Yazoo Basin, Yazoo Area Pump Project Report, July 1982, presented a reevaluation of the economic feasibility of the pumping stations features of the backwater project. This report recommended installation of a 17,500-cfs pumping station at Steele Bayou. In December 1985, the plan changed because budgetary guidance directed by the Work Allowance of 1986 did not provide funds for the 17,500-cfs pumping station. Instead, the allowance provided funds for Engineering and Design for a 10,000-cfs capacity pumping plant to be located approximately 1 mile west of the existing Steele Bayou structure. Several design documents and Technical Reports have been prepared for the alternate pumping plant. These documents are listed in Table 6-1.

TABLE 6-1
STATUS OF REPORTS

Title	Completion Date
Vicksburg District	
Pump and Driver Feasibility Study	May 84
Design Memorandum No. 18, Site Selection	Jan 85
Channel Work Report	Feb 85
General Design Memorandum No. 20	Apr 85
Supplement No. 1 to General Design Memorandum No. 20	Jun 87
Design Memorandum No. 19, Pump and Prime Mover	Nov 88
U.S. Army Engineer Research and Development Center	
Pumping Plant Inflow, Discharge Hydraulics Generalized Pump Sump Research Study, HL-88-2	Feb 88
Formed Suction Intake Approximate Appurtenance Geometry, HL-90-1	Feb 90
Yazoo Backwater Pumping Station Discharge Outlet, HL-90-4	May 90
Little Sunflower River Drainage Structure	28 Jul 75
Collins Creek Drainage Structure	16 Aug 76
Satartia Area Levee	22 Nov 76
Connecting Channel, Steele Bayou to Big Sunflower River	20 Jun 78
Yazoo Backwater Levee, Mississippi River Levee to LAC Levee	20 Jun 78
Muddy Bayou Control Structure	18 Jul 78
Greentree Reservoirs	Dec 91
Steele Bayou Drainage Structure	17 Jan 69
Technical Report 3-480, Geological Investigations of Yazoo Basin, Vicksburg Quadrangle	1979
Technical Report 4-87-1, U.S. Army Corps Wetland Delineation Manual	
Technical Report HL-88-2, Pumping Station Inflow - Discharge Hydraulics, Generalized Pump Sump Research Study	Feb 88

j. Fish and Wildlife Mitigation Report, July 1982, was prepared in conjunction with the reevaluation efforts of the Yazoo Area Pump Project, Yazoo Area, and the Satartia Area Backwater levee Projects. This report was used as a basis for determining the modifications that should be made to achieve a balance in the use of the backwater area's natural resources. The report included the mitigation analyses for the construction and operation of the Yazoo Area and Satartia Area Backwater Levee Projects, including the connection channel, structures, the recommended Yazoo Area Pump Project, and other appurtenances. The Fish and Wildlife Mitigation Report recommended the acquisition of 40,000 acres of woodlands through perpetual easements in the project area.

k. Yazoo Basin, Yazoo Backwater Area, Mississippi, Mississippi Mitigation Plan Report, October 1989, presented a proposal for mitigation implementation to compensate for terrestrial wildlife losses incurred during construction and operation of the Yazoo Area and Satartia Area levees. This report recommended the purchase of 8,400 acres of frequently flooded cleared farmland to be reforested for terrestrial wildlife habitat through the acquisition of fee title. In 1990, the U.S. Army Corps of Engineers, Vicksburg District, purchased a tract of land containing 8,800 acres--this property is referred to as the Lake George Property. It is located in Yazoo County between the Delta National Forest and the Panther Swamp National Wildlife Refuge.

l. Upper Steele Bayou Reformulation Report, December 1992. Recommendations were made in this report for additional flood control improvements in the upper Steele Bayou Basin for Black Bayou, Main Canal, Ditch 6, and Robertshaw Ditch.

m. Memorandum for President, Mississippi River Commission, 2 December 1993, subject: FC/MR&T, Yazoo Basin, Mississippi, Big Sunflower, Bogue Phalia, Little Sunflower, Holly Bluff Cutoff, Bogue Phalia Cutoff, and Dowling Bayou Channel Maintenance Project. This memorandum outlined the plan for preparing the Supplement D (to GDM No. 1) report.

n. UYP Reformulation Report, December 1993. This report was prepared to identify and evaluate plans for greater levels of flood protection, reduce levels of agricultural intensification, and reduce adverse impacts of the environment for the UYP including alternative reservoir operations and flood damage reduction alternatives for the Yazoo Backwater Area in addition to the Yazoo Backwater pumping plant.

o. Flood Control, Mississippi River and Tributaries, Yazoo Basin, Big Sunflower River Basin Channel Maintenance, November 1994, Supplement D to GDM No. 1. Supplement D was approved by Mississippi River Commission 1st endorsement, 1 February 1995, subject to resolution of comments.

EXISTING WATER PROJECTS

6. There are five existing projects within the subarea of the Yazoo Backwater--Yazoo, Satartia, Satartia Extension, Rocky Bayou, and Carter (see Plate 4-1). Although these projects are separate elements of the Yazoo Basin Backwater Project, they are part of the flood control measures authorized in 1941, 1944, 1965, and 1986. A brief description of the authorized improvements for these existing projects follows:

a. Yazoo Area (926,000 acres). This project area is located between the east bank Mississippi River levee and the Will M. Whittington Auxiliary Channel. The area extends north from Vicksburg, Mississippi--a distance of approximately 65 miles to Belzoni, Mississippi. Authorized work in the Yazoo Area consists of a levee system 30.5 miles long, extending from the end of the east bank Mississippi River levee, generally along the west bank of the Yazoo River to a connection with the west levee of the Will M. Whittington Auxiliary Channel. This levee system includes two structures, one at Steele Bayou with a design capacity of 19,000 cfs and one at Little Sunflower River with a design capacity of 8,000 cfs, and a channel between the Sunflower River and Steele Bayou to connect the upper and lower ponding areas within the Yazoo Area. The levee system is completed to an interim grade of 107.0 feet, National Geodetic Vertical Datum (NGVD). The work also includes 24 miles of channel work, two major structures, and two river closures. This work is complete and now operational. A list on the status of projects located in the vicinity of the Yazoo Backwater Area can be found in Table 6-1.

b. Satartia Area (28,800 acres). The Satartia area is located south of Satartia, Mississippi, between the Yazoo River on the west and the hill line on the east. Authorized work in the area consists of 20 miles of levee and one major structure. Protection of this area was completed in November 1976.

c. Satartia Extension Area (3,200 acres). This area is located south of the Satartia area also between the Yazoo River on the west and the hill line on the east. Protection includes 8.2 miles of levee and floodgate for drainage. Currently, no flood control features are authorized for the Satartia Extension Project.

d. Rocky Bayou (14,080 acres). The Rocky Bayou area is located south of the city of Yazoo City, Mississippi, between the Yazoo River on the west and the hill line on the east. Authorized improvements consist of about 19 miles of levee and one major structure. Levee Item 1, which is the reach along O'Neal Creek, was separated into two construction contracts--Items 1A and 1B. Item 1A, a 3.0-mile levee item, was awarded 25 March 1985 and is complete. Item 1B, a 0.7-mile reach and a small structure, was awarded on 12 November 1986.

e. Carter Area (102,400 acres). The Yazoo River and the Will M. Whittington Auxiliary Channel are on the west boundary of the project area on the east. The area begins upstream of the confluence of the Big Sunflower and the Yazoo Rivers. Improvements authorized for the Carter area consist of about 29 miles of levee and one major structure. Studies are underway to review flood control needs of the area.

PROJECT LOCATION

7. This appendix is concerned specifically with the Yazoo Area of the Yazoo Backwater Project. The area, as depicted on Plate 4-1, lies in west-central Mississippi between the Mississippi River east bank levee and the hill line on the east. The triangular-shape area extends northward approximately 60 miles to the latitude of Hollandale and Belzoni, Mississippi, and comprises about 1,550 square miles. Big Sunflower and Little Sunflower Rivers, Deer Creek, and Steele Bayou flow through the project area. Interior drainage of the area is accomplished by structures at Little Sunflower River (upper ponding area) and Steele Bayou (lower ponding area).

ALTERNATIVES

GENERAL

8. There were many alternative plans considered during the evaluation of the Yazoo Backwater Reformulation Study. The array of alternatives are discussed in detail in the Main Report to this appendix. A brief synopsis is given in the following paragraphs.

9. The Yazoo Backwater Reformulation Study began by analyzing structural flood control features consisting of five pump size alternatives and a levee alternative. The five pump alternatives that were originally analyzed in the 1982 Reevaluation Report were reanalyzed. The 10,500-, 14,000-, 17,500-, 21,000-, and 24,500-cfs pump stations were reanalyzed, and their location was to be adjacent to the Steele Bayou structure.

10. A levee alternative was developed to basically open the Big Sunflower River Basin back to Mississippi River Backwater flooding. The Yazoo Backwater levee would be realigned along the Big Sunflower and Little Sunflower Rivers to a point near Highway 49 West, where it would tie back into natural ground as shown on Plate 4-5. The levee alignment was designed to skirt the wildlife management forested areas along the Big and Little Sunflower Rivers such that minimal damage to the environment would occur. Approximately 61 structures would be required to protect the landside areas of the levee and some lengthy landside drainage ditches would also be required. The connecting channel between the Big Sunflower Basin and the Steele Bayou Basin would be closed off, thereby establishing a drainage divide between the two basins and the closure at Big Sunflower River opened to pass flows and protected to serve as a way to maintain low water levels. The Little Sunflower structure would be modified to maintain a minimum ponding area for waterfowl and aquatic habitat.

11. After going through the first array of structural flood control alternatives mentioned above, the 14,000-cfs pump was selected as the most feasible pump size. This plan had a pump on/off elevation of 85.0 feet, NGVD, from December through February and an on/off elevation of 80.0 feet, NGVD, from March through November. Shortly after this, several public meetings were held and a consensus group was formed with interested Federal agencies, state agencies, wildlife interests, environmental agencies, and other groups. After the public meetings and consensus group meetings, a very large array of pump alternatives were considered. These approximately 35 alternatives looked not only at structural flood control, but also the combination of structural and nonstructural flood control. Nonstructural flood control measures include reforestation by buying easements on open lands, nontraditional operation of the pumping station to include various ponding levels and pump on/off operation, and the purchasing of all lands below the 100-year frequency flood level.

12. The large arrays of alternatives were narrowed down to seven alternative plans for the final array for detailed evaluation. The final array of alternatives are described below:

a. Plan 1. No Action.

b. Plan 2. Wholly nonstructural plan (Environmental Protection Agency (EPA) plan; no pump with voluntary conservation easements on open lands with reestablishment of forest and floodproofing of structures or Corps plan).

c. Plan 3. A 14,000-cfs pump with a year-round pump elevation of 80.0 feet, NGVD, at Steele Bayou and acquisition and reestablishment of forest on 17,500 acres of open land for compensatory mitigation (aquatic spawning habitat losses).

d. Plan 4. A 14,000-cfs pump with a year-round pump elevation of 85.0 feet, NGVD, at Steele Bayou and voluntary conservation easements and reestablishment of forest on 40,100 acres of open land.

e. Plan 5. A 14,000-cfs pump with a year-round pump elevation of 87.0 feet, NGVD, at Steele Bayou and voluntary conservation easements and reestablishment of forest on 62,500 acres of open land.

f. Plan 6. A 14,000-cfs pump with a year-round pump elevation of 88.5 feet, NGVD, at Steele Bayou and voluntary conservation easements and reestablishment of forest on 77,300 acres of open land. Operation of the Steele Bayou structure would be modified to maintain a 70- to 73-foot, NGVD, elevation at Steele Bayou during low-water periods and allow natural Mississippi River backwater flooding up to elevation 87.0 feet, NGVD (1-year base conditions frequency annual flood event).

g. Plan 7. A 14,000-cfs pump with a year-round pump elevation of 91.0 feet, NGVD, at Steele Bayou and voluntary conservation easements and reestablishment of forest on 107,000 acres of open land. Includes conservation easements to preserve 91,600 acres of existing forest lands. Operation of the Steele Bayou structure would be modified to maintain a 70- to 73-foot, NGVD, elevation at Steele Bayou during low-water periods and allow natural Mississippi River backwater flooding up to elevation 87.0 feet, NGVD (1-year base conditions frequency annual flood event).

13. The recommended plan as a result of all the alternatives analyzed is Plan 5.

SECTION 2 - HYDROLOGY AND HYDRAULICS

PURPOSE OF HYDROLOGIC ANALYSIS

14. The purpose of these hydrologic analyses is to identify the base hydrologic conditions in the Yazoo Backwater Area and estimate the changes to those conditions resulting from various flood control alternatives. Subsequent economic and environmental analysis will be made using this hydrologic data in development of a recommended plan.

15. This section presents the methodology used in the hydrologic analyses and explains the types of data used in the analysis which support the formulation of the recommended plan.

DESCRIPTION OF YAZOO BACKWATER AREA

16. The Mississippi River Mainline Levees are designed to protect the alluvial valley from extreme flood events by confining flow to the leveed floodway, except where it enters the natural backwater areas or is diverted intentionally into floodway areas. When major floods occur and the carrying capacity of the Mississippi River leveed channel is threatened, additional conveyance through the Birds Point-New Madrid Floodway and relief outlets through the Atchafalaya Basin Floodway, Morganza Floodway, and Bonnet Carre Floodways are utilized as well as the storage capacity of flat lowlands at the junctions of tributaries with the Mississippi River. These tributary areas are commonly referred to as backwater areas and are in effect mid-river reservoirs that store water during major floods. The Yazoo River tributary area is commonly known as the Yazoo Backwater Area. The Yazoo Backwater levees were built to protect a major portion of the Mississippi Delta from major Mississippi River floods and are

primarily designed to overtop prior to the Mississippi Project Design Flood (PDF) peak such that storage is made available in order to reduce the level of the PDF, thus resulting in a lesser levee grade along the mainline levees.

DRAINAGE AREAS

17. The Yazoo Area has a drainage area comprised of the Little Sunflower River, Big Sunflower River, Deer Creek, and Steele Bayou Basins as shown on Plate 4-2. These streams have a total drainage area of 4,093 square miles of the alluvial valley of the Mississippi River commonly called the Mississippi Delta. The area extends from the confluence of Steele Bayou with the Yazoo River north to the vicinity of Clarksdale, Mississippi, and has an average width of approximately 30 miles. The Mississippi Delta alluvial plain is generally flat with slopes averaging 0.3 to 0.9 foot per mile. Drainage areas of the four basins can be seen in Table 6-2.

TABLE 6-2
YAZOO AREA DRAINAGE BASIN AREA

Stream	Drainage Area (sq mi)
Big Sunflower River	2,832
Little Sunflower River	309
Deer Creek	200
Steele Bayou	752
Total	4,093

CLIMATE

18. The climate of the Yazoo Area is primarily humid, subtropical with abundant precipitation. The summers are long and hot; the winters are short and mild. The average annual temperature is about 64 degrees F. Average monthly temperatures range from 44 degrees F in January to 82 degrees F in July and extremes range from about -10 degrees F to 110 degrees F.

PRECIPITATION

19. The average annual rainfall over the Yazoo Backwater Area is approximately 51 inches. Normal monthly rainfall varies from 5.81 inches in March to 2.58 inches in October. Snowfall occurs about once a year with an average of approximately 2 inches.

INFILTRATION AND RUNOFF

20. Runoff factors vary from 10 percent in the summer months to 70 percent in the spring and winter months, depending on antecedent conditions, rainfall distribution, and rainfall intensity. Seasonal variations in runoff factors are shown by the monthly-generalized values in Table 6-3.

TABLE 6-3
MONTHLY PERCENT RUNOFF

Month	Percent Runoff
January	60
February	60
March	70
April	70
May	60
June	40
July	25
August	10
September	10
October	25
November	25
December	60

HISTORY OF FLOOD PROBLEMS

BASE CONDITIONS FLOODING

21. When the Little Sunflower River and Steele Bayou structures are closed because of high stages on the Mississippi River, flooding from ponding of interior drainage is the principal problem in the project area. However, the impoundment of floodwater is much less than it would be if the Yazoo Backwater levees were not in place today. Major problems that have resulted from frequent flooding include flood damage to agricultural crops, rural residential property, commercial fisheries, timber management, and public roads and bridges. Major floods have caused undue hardships and economic losses to residents of the area due to flooding of homes and disruption of sanitation facilities and lines of communications.

22. Three important factors which affect flood losses in the Yazoo Area are time of year, duration, and frequency of flooding. These factors are very critical for the agricultural lands, but are just as important to the forested areas, lakes, streams, commercial fisheries, wildlife management areas (WMA), wetland areas, and rural residential areas. Frequent or intermittent floods can occur any time of the year. However, flood records indicate that the majority of floods occur during the months of March through June, which is typically the time land preparation and spring crop planting occurs. Land use acreages in the Yazoo Area are shown in Tables 6-4 through 6-7.

MAJOR BACKWATER FLOOD EVENTS

23. The alluvial lands of the Yazoo Backwater area have always been subject to flooding by the Mississippi River. From 1897 through 1937, massive floods inundated the region regularly. Then for a 35-year period less severe flooding occurred, causing many to dismiss massive floods as a thing of the past. In 1973, a severe flood again devastated the area. Other destructive floods followed in rapid succession in 1974, 1975, 1979, 1983, 1984, 1991, 1993, and 1997. Hundreds of persons were forced from their homes; crops and buildings were damaged or lost; and wildlife was destroyed.

Flood of 1973

24. Beginning in late September 1972 and continuing through the spring of 1973, unusual meteorological and hydrological events persisted with a relentless variety of phenomena over areas and basins in the Vicksburg District. Severe weather in the form of intense thunderstorms, tornadoes, high winds, and rain was observed at frequent and recurring intervals, inflicting

TABLE 6-4
TOTAL LAND USE WITHIN THE YAZOO AREA

Land Use	Acres	Adjusted Acres a/	Wetlands	Acres	Adjusted Acres a/
Cotton	178,042	175,794	Nonhydric	187,763	184,873
Soybeans	299,793	269,885	Prior Converted	365,894	345,115
Corn	476	396	Farmed Wetlands	45,390	21,702
Rice	59,648	48,820	Unclassed	1,629	1,544
Herbaceous	46,299	42,660			0
Pasture	16,408	15,670			0
Total Cleared	600,664	553,224	**Total Cleared**	600,676	553,234
Bottom-land Hardwoods	235,350	149,164	Bottom-land Hardwoods	235,350	149,164
Swamp	39,355	31,047	Swamp	39,355	31,047
Total Forested	274,705	180,211	**Total Forested**	274,705	180,211
River	4,278	3,688	River	4,278	3,687
Lake	14,121	12,510	Lake	14,121	12,510
Pond	32,121	31,535	Pond	32,121	31,535
Cloud/Sandbar	12	10	Cloud/Sandbar	0	0
Total Water	50,532	47,743	**Total Water**	50,520	47,733
WMA		91,541	WMA		91,541
NWR		27,095	NWR		27,095
WRP		22,596	WRP		22,596
CRP		3,491	CRP		3,491
Total Managed		144,723	**Total Managed**		144,723
Total	925,901	925,901	**Total**		925,901

NOTE: WMA - Wildlife Management Area
NWR - National Wildlife Refuge
WRP - Wetland Reserve Program
CRP - Conservation Reserve Program

a/ Adjusted acres - the land use acres were adjusted by removing all lands managed by state and Federal agencies or under Federal programs.

TABLE 6-5
LAND USE WITHIN THE 100-YEAR FLOOD OF THE YAZOO AREA

Land Use	Acres	Adjusted Acres a/	Wetlands	Acres	Adjusted Acres a/
Cotton	71,939	70,179	Nonhydric	73,300	71,843
Soybeans	205,287	176,083	Prior Converted	240,337	221,102
Corn	418	337	Farmed Wetlands	46,142	21,471
Rice	44,793	34,282	Unclassed		1,199
Herbaceous	28,723	25,620			
Pasture	9,889	9,110			
Total Cleared	361,049	315,611	**Total Cleared**	361,055	315,615
Bottom-land Hardwoods	204,218	121,525	Bottom-land Hardwoods	204,218	121,526
Swamp	29,651	22,146	Swamp	29,651	22,145
Total Forested	233,869	143,670	**Total Forested**	233,869	143,671
River	3,791	3,225	River	3,791	3,225
Lake	12,377	10,869	Lake	12,377	10,877
Pond	18,628	18,216	Pond	18,628	18,215
Cloud/Sandbar	7	5	Cloud/Sandbar	0	0
Total Water	34,803	32,315	**Total Water**	34,796	32,317
WMA	0.0	89,927	WMA		89,923
NWR	0.0	22,184	NWR		22,183
WRP	0.0	22,535	WRP		22,534
CRP	0.0	3,478	CRP		3,477
Total Managed	0.0	138,124	**Total Managed**		138,117
Total	629,721	629,721	**Total**	629,721	629,721

NOTE: WMA - Wildlife Management Area
NWR - National Wildlife Refuge
WRP - Wetland Reserve Program
CRP - Conservation Reserve Program

a/ Adjusted acres - the land use acres were adjusted by removing all lands managed by state and Federal agencies or under Federal programs.

TABLE 6-6
LAND USE OF BACKWATER AREA
BY REACH IN ACRES

Land Use	Acres					Adjusted Acres a/				
	Reach 1	Reach 2	Reach 3	Reach 4	Total	Reach 1	Reach 2	Reach 3	Reach 4	Total
Cotton	76,592	32,538	10,140	59,070	178,295	75,686	32,522	8,969	58,918	176,095
Soybeans	134,500	78,831	16,348	69,880	299,532	126,671	68,521	11,131	63,332	269,654
Corn	456	19	1	0	476	379	15	1	0	396
Rice	32,802	20,512	924	5,360	59,593	26,423	16,574	528	5,259	48,784
Herbaceous	19,223	10,905	2,054	14,207	46,380	17,549	10,332	1,622	13,235	42,738
Pasture	8,271	1,972	701	5,493	16,430	7,960	1,922	607	5,212	15,701
Total Cleared	271,844	144,775	30,169	154,009	600,706	254,668	129,886	22,858	145,956	553,368
Bottom-land hardwoods	103,335	19,493	71,443	40,846	235,219	84,942	17,899	21,867	24,426	149,134
Swamp	18,199	4,663	7,009	9,596	39,469	15,210	4,368	3,882	7,686	31,146
Total Forested	121,534	24,156	78,451	50,442	274,687	100,151	22,267	25,749	32,113	180,280
River	1,506	125	2,248	407	4,291	1,412	103	1,950	230	3,695
Lake	12,386	388	755	584	14,104	11,198	358	420	524	12,501
Pond	5,056	4,902	2,355	19,794	32,100	4,610	4,850	2,331	19,730	31,521
Sandbar/cloud	8	2	1	2	12	7	2	1	2	10
Total Water	18,957	5,416	5,359	20,786	50,508	17,228	5,313	4,702	20,486	47,728
WMA						19,794	213	59,663	11,687	91,357
NWR						13,103	0	0	13,963	27,067
WRP						6,863	13,892	805	1,034	22,594
CRP						527	2,777	202	0	3,507
Total Managed						40,288	16,882	60,670	26,684	144,524
Total	412,335	174,348	113,980	225,238	925,901	412,335	174,348	113,980	225,238	925,901

NOTE: WMA - Wildlife Management Area
NWR - National Wildlife Refuge
WRP - Wetland Reserve Program
CRP - Conservation Reserve Program

a/ Adjusted acres - the land use acres were adjusted by removing all lands managed by state and Federal agencies or under Federal programs.

TABLE 6-7
LAND USE WITHIN THE 100-YEAR FLOOD OF THE YAZOO AREA
BY REACH IN ACRES

Land Use	Acres					Adjusted Acres a/				
	Reach 1	Reach 2	Reach 3	Reach 4	Total	Reach 1	Reach 2	Reach 3	Reach 4	Total
Cotton	24,553	11,322	7,708	28,646	72,229	24,314	11,307	6,530	28,494	70,645
Soybeans	77,391	58,263	14,734	54,592	204,980	71,125	47,912	9,488	48,033	176,558
Corn	385	19	1	0	405	309	15	1	0	325
Rice	22,622	17,149	904	4,198	44,873	16,545	13,196	506	4,096	34,343
Herbaceous	10,161	6,681	1,688	9,958	28,487	9,192	6,106	1,254	8,984	25,536
Pasture	4,225	1,160	503	3,619	9,507	4,006	1,110	409	3,337	8,862
Total Cleared	139,338	94,594	25,538	101,012	360,481	125,491	79,645	18,189	92,944	316,269
Bottom-land hardwoods	80,261	15,520	71,202	36,600	203,583	65,674	13,920	21,360	20,151	121,105
Swamp	11,491	2,979	6,731	8,156	29,357	9,450	2,683	3,589	6,242	21,964
Total Forested	91,753	18,499	77,933	44,755	232,940	75,124	16,603	24,949	26,393	143,070
River	1,317	110	1,947	375	3,748	1,267	88	1,648	198	3,200
Lake	10,674	304	752	502	12,231	9,609	274	415	443	10,740
Pond	2,933	3,313	261	12,104	18,611	2,734	3,261	237	12,040	18,271
Sandbar/cloud	5	1	0	1	6	4	1	0	1	5
Total Water	14,928	3,727	2,960	12,982	34,597	13,613	3,623	2,300	12,681	32,217
WMA						17,714	214	59,980	11,708	89,616
NWR						6,678	0	0	13,988	20,666
WRP						6,874	13,946	810	1,035	22,665
CRP						524	2,788	203	0	3,516
Total Managed						31,790	16,948	60,993	26,731	136,463
Total	246,081	116,820	106,431	158,749	628,018	246,018	116,820	106,431	158,748.8	628,017.6

NOTE: WMA - Wildlife Management Area
NWR - National Wildlife Refuge
WRP - Wetland Reserve Program
CRP - Conservation Reserve Program

a/ Adjusted acres - the land use acres were adjusted by removing all lands managed by state and Federal agencies or under Federal programs.

widespread flooding and extensive property damage. Storm cells pelted some areas with measured precipitation which exceeded amounts expected to occur on an average of only once in 100 years. Flooding in the Yazoo Backwater Area was the worst recorded since the 1937 flood. The resulting damage to prime Delta farmlands and properties was the highest ever experienced because of extensive developments over the past years. The 1973 flood created a body of water 60 miles long (almost as large as the Great Salt Lake) and the flood stage lasted almost 9 months.

Flood of 1974

25. The 1974 high water season began in November 1973 and continued through May 1974. Continuing rains kept streams above damage levels. The situation was worsened when backwater from the rising Mississippi River was added to headwater runoff. Families in portions of Sharkey, Issaquena, and Warren Counties, many of whom had only recently returned to their homes from the 1973 flood, were once again forced to evacuate.

Flood of 1975

26. The third consecutive year of significant flooding throughout the Yazoo Backwater Area began during December 1974. About 90 percent of Sharkey and Issaquena Counties was inundated, and between 700 and 800 families were evacuated from the flooded area. The Yazoo Backwater levees were not completed during this flood event.

Flood of 1979

27. This flood occurred after the Yazoo Backwater levee was completed and began as the Mississippi River started to rise early in 1979. By 1 March, due to a combination of rainfall in the Yazoo Area and high Mississippi River stages, Steele Bayou began to rise above elevation

80 feet, NGVD--the elevation at which flood damages begin to occur. On 4 March, as water reached elevation 82.5 feet, NGVD, the Steele Bayou gates were closed to prevent the Mississippi and Yazoo Rivers from flowing into the Yazoo Area. The Little Sunflower River structure was closed on 5 March as water reached 85.05 feet, NGVD. On both the river and landsides of the Backwater levees, the water continued to rise, with the riverside reaching peak elevations of 97.2 and 97.6 feet, NGVD, on 28 April at the Steele Bayou and Little Sunflower River structures, respectively. Due to the large amount of rainfall in the Yazoo area, the land side did not reach its peak of 96.6 feet, NGVD, at the Little Sunflower River structure until 5 May. The Mississippi and Yazoo Rivers, which had begun their fall several days before, fell low enough for the floodgates to be opened at Steele Bayou on 4 May at elevation 96.3 feet, NGVD, and Little Sunflower River on 5 May at elevation 96.6 feet, NGVD. This decline continued until water fell below the damage elevation in the Steele Bayou area on 14 June and the Little Sunflower area on 15 June 1979 ending a flood which lasted 104 days and flooded a maximum of 350,400 acres. Without the Yazoo Backwater levees and structures, approximately 400,000 acres would have been flooded. Many homes in the Eagle Lake area were threatened with major flooding as water levels were within inches of the natural ridge protecting the area adjacent to the Muddy Bayou structure. Emergency efforts to raise the ridge by the Corps were successful during this event; however, lake water levels were raised to elevation 90.0 feet, NGVD, with flow through the Muddy Bayou structure in preparations to lessen catastrophic damage which would have occurred had Steele Bayou stages risen another inch or two.

Flood of 1983

28. The 1983 flood began with heavy rains in the Mississippi River Basin occurring early in April. Prior to this time, stages had receded to well below bank full after a significant rise during December and January. Two weeks after the early April rainfall, additional rain occurred through the Mississippi River Basin which contributed to the rise on the lower Mississippi River.

Three storms occurred from late April until late May, producing rainfall totals up to 16 inches in the Lower Ohio and Mississippi River Basins. Flooding in the Yazoo Area actually began in December 1982 and peaked at 92.0 feet, NGVD, on 11 January and fell to below the damage elevation of 80.0 feet, NGVD, on 19 February. The Mississippi River began to rise again above the damage elevation of 80.0 feet, NGVD, on 8 April and peaked at 95.8 feet, NGVD, on 7 June. The flood receded on 30 June 1983.

Flood of 1984

29. The 1984 Yazoo Backwater flood began on 26 March due to a rising Mississippi River and peaked on 29 May at 92.0 feet, NGVD. The flood receded below the damage elevation of 80.0 feet, NGVD, on 16 June. The riverside elevation peaked at 94.5 feet, NGVD, on 25 May.

Flood of 1991

30. The 1991 Yazoo Area flood was a headwater flood that caused tremendous flooding in the Upper Yazoo Area. The flooding in the Yazoo Area peaked at elevation 92.46 feet, NGVD, on 6 May. The Steele Bayou and Little Sunflower River floodgates never closed during this flood event because the riverside elevation reached a peak of 90.8 feet, NGVD, on 4 May.

Flood of 1993

31. The flood of 1993 primarily affected the Upper Mississippi River and its tributaries. High antecedent soil moisture followed by persistent, heavy rainfall from April through September produced disastrous flooding in the Upper Mississippi Basin. The effect on the Lower Mississippi River was not great. The flood of 1993 demonstrated that during high Upper

Mississippi River discharges, flooding on the Upper Mississippi River alone would not produce a major flood event on the Lower Mississippi River. The Yazoo Area began flooding on 13 March and reached an elevation of 91.5 feet, NGVD, on 19 May. The flood receded on 7 June. The Mississippi River rose again on 16 July due to the Upper Mississippi River flooding and reached an elevation of 86.5 feet, NGVD, on 12 August. The flood receded on 2 September.

Flood of 1997

32. The Flood of 1997 began with the Mississippi River reaching the highest flood levels experienced at Arkansas City, Arkansas, and Natchez, Mississippi, since 1973 and the highest at Greenville and Vicksburg, Mississippi, since 1983. The 1997 Mississippi River flood was the fourth highest of record at Natchez and Cairo following close behind 1927, 1937, and 1973. The flooding in the Yazoo Area reached a peak elevation of 93.3 feet, NGVD, on 8 April. The riverside reached a peak elevation of 98.2 feet, NGVD, on 23 March.

FLOOD CONTROL

PROJECT FEATURES

33. Completed flood control projects in the Yazoo Area are shown on Plate 4-3. These features include the following:

a. Yazoo Backwater Levee connects to the end of the east bank Mississippi River levee just north of Vicksburg and extends eastward to the downstream end of the west bank Will M. Whittington Lower Auxiliary Channel Levee. The Yazoo Backwater levee has a net levee grade of elevation 107.0 feet, NGVD. The Yazoo Backwater levee is considered an overtopping section to the mainline levee of the Mississippi River, except for 1,000 feet on each side of the

Steele Bayou and Little Sunflower structures. These 30.5 miles of overtopping levee ensure that in case of the Mississippi River and Tributaries Project Design Flood (PDF), the storage in the Yazoo Backwater area will be utilized to reduce the risk of overtopping the main stem levee.

b. Steele Bayou structure is located 3,200 feet upstream of the confluence of Steele Bayou and the Yazoo River. The structure consists of four vertical lift gates 30 by 22.5 feet, concrete-paved approach channel, and a stilling basin. The Steele Bayou ponding area is connected by a 200-foot bottom width channel to the Little Sunflower ponding area. Construction of the Steele Bayou structure was begun on 22 July 1965 and completed 17 January 1969.

c. Two connecting channels play a vital part in the operation of the Yazoo Backwater Project. One is a 200-foot bottom width channel between the Big and Little Sunflower Rivers. The Little Sunflower River is enlarged between this connecting channel and the Little Sunflower Structure. The other connecting channel is a 200-foot bottom width channel between the Little Sunflower River and Steele Bayou, which also intercepts Deer Creek flow. The purpose of the channel connecting the Sunflower ponding area with the lower and larger Steele Bayou ponding area is to make the most efficient and economical use of the available storage.

d. Little Sunflower structure is located opposite Yazoo River RM 32.6, approximately 21 miles northeast of Vicksburg. The structure consists of two vertical lift gates 25.0 by 22.5 feet, concrete-paved approach channel, and a stilling basin. Construction of the structure was completed 28 July 1975.

e. Muddy Bayou control structure is located 13 miles northwest of Vicksburg in the Yazoo Backwater Area on Muddy Bayou--a tributary of Steele Bayou--approximately 1,300 feet from its mouth at RM 11.4 of Steele Bayou. The control structure consists of two 20- by 12-foot vertical lift gates--the Muddy Bayou Channel (a cutoff dam adjacent to the structure) and an

access road from Mississippi Highway 465. The control structure was completed 18 August 1977, controls all water flowing in or out of Eagle Lake through Muddy Bayou, provides flood protection to the Eagle Lake area during periods of moderately high stages (elevation 95.0 feet, NGVD) on Steele Bayou, and provides the means of regulating pool stages in Eagle Lake.

EXISTING PROJECT OPERATION

34. The primary purpose of the Yazoo Backwater Project is to provide flood protection from the Mississippi and Yazoo Rivers to areas in the Lower Mississippi Delta. During periods of high water stages on the Mississippi and Yazoo Rivers, the floodgates (Steele Bayou and Little Sunflower) are closed, necessitating storage of interior drainage within the ponding areas. The interior areas will pond up until the riverside tailwater subsides and the interior water can be released through the floodgates.

35. The Steele Bayou Floodgate is the principal structure for the Yazoo Backwater Project. Anytime the stage on the landside of the Steele Bayou and Little Sunflower structures is higher than the riverside and above 70 feet, NGVD, the gates are opened. With a rising river, the interior ponding areas are allowed to rise to an elevation of 75.0 feet, NGVD. The floodgates are closed when the river elevation is higher than the interior ponding levels.

36. The Steele Bayou structure is operated to control minimum water levels in the Steele Bayou and Little Sunflower ponding areas. The present criterion calls for holding minimum water levels in the ponding areas between 68.5 and 70.0 feet, NGVD.

37. The interior ponding areas are primarily agricultural and forested lands. Several developed areas exist in the Yazoo Backwater Area. Interior flood damage begins at approximately 80.0 feet, NGVD. Although the interior area is protected from the high stages of the Mississippi

and Yazoo Rivers, it is subject to flooding resulting from inflow into the ponding areas from Steele Bayou, Deer Creek, Little Sunflower River, and Big Sunflower River.

HYDROLOGIC AND HYDRAULIC ANALYSES

COMPUTER MODELS USED

38. The structural flood control component of each plan was analyzed using two computer models to simulate the hydrology and hydraulics of the Yazoo Backwater Project Area. The HEC-IFH computer model was used to develop the hydrologic data to be used as input into the period-of-record routing model. The period-of -record routing computer model was developed and modified by the Vicksburg District to simulate the actual hydraulics of the area. This model is a two-ponding area model connecting the two ponding areas (upper and lower) with a connecting channel similar to what exists in the area. The data base for these models reflects current conditions for the period 1943 to 1997. Data developed include descriptive relationships and observed data. These will be discussed in further detail in the following paragraphs.

DESCRIPTIVE RELATIONSHIPS

ECONOMIC AND HYDROLOGIC REACHES

39. Economic reaches were developed for this study to include a pump station alternative (five pump sizes) and a levee alternative as shown on Plate 4-4. The economic reaches used for the pump station alternatives were the same as for the levee alternative described earlier in this report. For clarification of the economic reaches, the descriptions of the reaches are as follows:

a. Reach 1: The Steele Bayou and Deer Creek drainage areas.

b. Reach 2: The area between Deer Creek and the proposed alignment of the west bank levee of the levee alternative.

c. Reach 3: The area along the Little and Big Sunflower Rivers which would remain unprotected with the levee alternative (riverside area between levees).

d. Reach 4: Lake George, Silver Creek, Dowling Bayou, and Big Widow areas which are east of the east bank levee of the levee alternative.

40. The hydrologic reaches developed for the levee alternative are identical to the economic reaches. The Lower and Upper Ponding Areas for the pump alternatives are as follows:

Reach 1 (Lower Ponding Area): Steele Bayou and Deer Creek Basins.

Reach 2, 3, and 4 (Upper Ponding Area): Little and Big Sunflower Basins.

The hydrologic reaches for the pump alternatives are connected by the 200-foot bottom width connecting channel.

Elevation-Area and Storage Curves

41. Elevation-area curves were developed for the economic and hydrologic reaches using a Geographic Information System (GIS). This system uses satellite aerial flood scenes as input

data to determine the elevation-area curves and land use data for each reach. The flood scenes that were used in developing the elevation-area curves and stream gages can be seen in Table 6-8.

TABLE 6-8
FLOOD SCENE STREAM GAGE ELEVATIONS
FOR REACHES 1-4

Flood Scene	Steele Bayou Gage Elevation (Reach 1)	Little Sunflower Gage Elevation (Reaches 2, 3, and 4)
	(ft, NGVD)	
December 2, 1987	66.2	70.8
February 17, 1984	76.1	81.4
March 12, 1973	77.2	82.2
March 5, 1987	79.5	82.4
February 1, 1993	83.0	83.2
April 30, 1991	N/A	91.7
March 10, 1989	89.7	90.0
January 13, 1983	91.9	93.1
January 30, 1974	90.6	93.4
May 5, 1973	100.3	100.3

42. The satellite scenes were classified with an unsupervised classifier. The classes were then grouped into basic categories--flooded and unflooded. The flooded category was subdivided into three classes--cleared, forested, and aquatic. The unflooded category was subdivided as cleared agricultural, forested, and herbaceous. In addition to the flood scenes, two other satellite images were utilized to classify the land use/land cover in the project area. Two satellite scenes from 1988 were used to prepare a multitemporal classification for land use. A classifier classed the scenes into 60 classes. Land use information was used to determine the correct land use category. Crop data were obtained from the U.S. Department of Agriculture. Other classes were determined by field verification. The land use/land cover scenes were broken down into the following classes--cotton, soybeans, corn, rice, herbaceous, pasture, ponds, bottom-land hardwoods, swamp, rivers, lakes, and sandbar/clouds. The classes were divided into three

categories--cleared, forested, and water. Later, the managed lands in the project area were digitized and the following classes were added--National Wildlife Refuges (NWR), WMA's, Wetland Reserve Program (WRP), and Conservation Reserve Program (CRP) lands. The land use and flood scenes were sandwiched to create a new coverage for each flood scene, which was the land use of the flooded area. In this way, a common year's land use was used for all flood scenes. The elevation-area curves were developed for the cleared, forested, and total categories. The elevation-area curves were developed by plotting the GIS flood scene elevations versus the area flooded on that date. A best fit curve routine was used to plot the curves.

43. Elevation-storage curves were developed by numerical integration of the computed elevation-area curves. Elevation-area curves are shown on Plates 4-7, 4-8, 4-9, and 4-10. Elevation-storage curves are shown on Plate 4-11.

Unit Hydrographs

44. Unit hydrographs developed from rainfall and stage-discharge hydrographs on the Big Sunflower River at Harvey Chapel and Little Calleo Landing were used as the basis for developing the synthetic unit hydrograph for the Upper Ponding Area (Reaches 2, 3, and 4). The unit hydrograph for the Lower Ponding Area (Reach 1) was developed by using observed data on Steele Bayou at Onward, Mississippi, gage. Inflow unit hydrographs are shown on Plates 4-12 and 4-13. The unit hydrographs reflect current conditions in the watershed and are also applicable to conditions assuming all currently approved Corps channel works in the watershed are completed. The rate at which flows from the Steele Bayou and Sunflower River watersheds enter the lower Delta's ponding area may be changed slightly if the conveyance capacity of the channels are modified, but the same volume of flow from the storm will reach the lower Delta. For example, analysis of the impacts of the Big Sunflower Channel Maintenance Project indicated that the maintained channel would shorten the travel time of major floods (having durations above flood levels of about 10 to 14 days) by about 12 hours. This is not a significant impact on the lower Delta because, if gates are open, the flood passes through the system; if gates are closed due to high Mississippi River stages, the water ponds in the lower Delta at a

slightly faster rate initially. In an event of 10- to 14-day duration, getting the peak rate of flow into the system 12 hours sooner and then storing the flow for another extended period, which could extend to possibly several months until Mississippi River stages recede, is not considered of any significant impact. With a potential pumping plant in place, increased channel conveyance in the upstream watershed would shorten travel times, thereby resulting in a requirement for storage (and potential flooding) until the pumps could evacuate the flow. However, this storage requirement will occur in almost all instances where major flows are experienced as the pump capacities investigated are below the peak inflow rates for all storms in excess of an approximate 1-year frequency.

Discharge Rating Curves

45. Tailwater discharge rating curves for the Steele Bayou structure, Little Sunflower structure, and connecting channel were developed from observed stages and measured discharges. These rating curves are shown on Plates 4-14 through 4-18.

Seepage

46. The Yazoo Backwater Project Area is bounded by about 260 miles of levees; therefore, seepage was considered to contribute some inflows to the ponding areas during high river stages. The levees were divided into reaches according to soil type, and curves relating seepage to head were developed for each type. The head for each reach was then correlated to the appropriate river gage, and a composite seepage curve for relating seepage inflow to the appropriate river gage was derived. The seepage curve used in the period-of-record routings is shown on Plate 4-19.

DAILY STAGE, PRECIPITATION, AND DISCHARGE DATA

STAGE GAGE DATA

47. Daily stage data for the 1-day (24-hour) routing periods used in the period-of-record routing model consisted of using the Mississippi River gage at Vicksburg and stage relating it to the tailwater of the Steele Bayou and Little Sunflower structures. The Mississippi River gage at Vicksburg discharge-rating curve was used to reflect expected conditions at the Steele Bayou and Little Sunflower gages for the period-of-record 1943 to 1997. Actual interior and exterior gage stage data (1973 to 1997) for the Steele Bayou and Little Sunflower structures were used to verify the accuracy of the period-of-record routings.

PRECIPITATION GAGE DATA

48. Precipitation data were obtained from as many as 12 contributing National Weather Service rainfall gage stations in developing the inflow hydrographs. The HEC-IFH computer model was used to develop the inflow hydrographs using the daily precipitation data. Station weights were assigned by the Thiessen Polygon technique and were recomputed as new stations were added and old ones were discontinued.

INTERIOR PONDING AREA INFLOWS

49. The inflow hydrographs used in the period-of-record routing model were developed by using the HEC-IFH model. Input to the model consisted of daily precipitation data, unit hydrographs, and runoff coefficients. The computed inflow hydrographs were used as input to the period-of-record routing model.

YAZOO RIVER FLOWS

50. Daily Yazoo River discharges were developed above the Little Sunflower River by using discharge-rating curves developed at the Yazoo City and Belzoni gages on the Yazoo River. These discharges were adjusted for headwater improvements and reservoir regulation.

PERIOD OF RECORD ROUTING MODEL ASSUMPTIONS

51. The following conditions were assumed in the recommended plan routing procedure:

a. Flooding in the upper area (Economic Reaches 2-4) and lower area (Economic Reach 1) was determined by using the Little Sunflower Structure landside gage and Steele Bayou structure landside gage locations. The elevation-area curves used in the period-of-record routing model take into account the effects of actual flooding in the ponding areas and adjacent areas by using actual GIS flood scenes.

b. The minimum ponding elevation was set at 73.0 feet, NGVD, year-round and used throughout the entire period-of-record.

c. Twelve pumps were operated at 1,167 cfs each. The actual head-discharge pump curve for the recommended pump station was used to simulate the pump operation (Plate 4-20). The number of pumps operated in any routing period was determined by the available storage above the minimum ponding elevation. In real time operational mode, flood forecasts of incoming flood hydrographs will be utilized in determining the actual number of pumps, which would need to be brought on-line to provide required flood protection.

d. The pump-on elevation used was 87.0 feet, NGVD, and the pump-off elevation was 87.0 feet, NGVD, for 1 January through 31 December for the entire period-of-record.

e. The floodgates and the pump station were not operated simultaneously due to the fact that the floodgates in a real time operation can pass more flow when the interior ponding elevation is higher than the exterior river elevation and based on the fact that damages to the pump could occur if operated against a negative head.

MODEL VERIFICATION

52. The period-of-record routing model was verified by using the data developed to represent base conditions and compared to actual observed gage elevations at the Steele Bayou structure landside gage. Plate 4-21 shows a comparison of a computed hydrograph for base conditions versus a computed recommended plan hydrograph.

PERIOD OF RECORD ROUTING MODEL RESULTS

STAGE-FREQUENCY CURVES

53. Stage-frequency curves were computed according to procedures outlined in "Statistical Methods in Hydrology," by Leo R. Beard. The period-of-record used was from 1943 to 1997. Annual and partial stage-frequency curves were computed for Base Condition and for all the array of alternatives using the graphical plotting position method. Table 6-9 depicts the stage-frequency data for base conditions and the final array of alternatives and the corresponding acres. Table 6-10 shows the reduction in stages for the recommended plan for the various flood frequency events. Table 6-11 shows the departures for the various frequency flood events for the current Yazoo Backwater Study recommended plan versus the revised 1982 Yazoo Backwater Report recommended plan (17,500-cfs pump, Plan 28, Array 3). The stage-frequency curves for Base Conditions are shown on Plate 4-22 and the stage-frequency curves for the Recommended Plan are shown on Plate 4-23.

TABLE 6-9
STAGE-FREQUENCY AND STAGE AREA DATA

Frequency Event	Base Conditions		Alternative (Final Array)									
			Plan 3		Plan 4		Plan 5		Plan 6		Plan 7	
Year	Elevation	Acres	Elevation	Acres	Elevation	Acres	Elevation	Acres	Elevation	Acres	Elevation	Acres
Lower Ponding Area (Reach 1)												
1	87.0	75,882	81.5	47,845	85.0	65,236	87.0	75,882	87.0	75,882	87.0	75,882
2	91.0	109,491	84.7	63,630	86.0	70,583	87.8	81,192	89.5	93,723	91.2	112,057
3	92.9	135,108	86.6	73,762	87.2	76,942	88.5	86,341	89.9	97,425	91.5	115,893
5	94.6	162,306	88.4	85,606	89.1	90,775	89.6	94,648	90.5	103,046	91.8	119,729
10	96.3	187,780	90.3	101,126	91.0	109,491	91.2	112,057	91.8	119,729	92.5	128,937
20	97.6	209,356	92.0	122,358	92.2	124,989	92.7	131,984	93.2	139,774	93.4	142,865
25	98.0	217,205	92.5	128,937	92.6	130,423	93.0	136,669	93.5	144,411	93.7	147,502
50	99.2	236,988	94.0	152,471	94.0	152,471	94.4	159,086	94.6	162,306	94.6	162,306
100	100.3	256,262	95.4	174,089	95.4	174,089	95.7	178,673	96.0	183,358	96.0	183,358
Upper Ponding Area (Reaches 2, 3, and 4)												
1	87.8	140,317	83.2	73,747	85.9	109,140	87.8	140,317	87.8	140,317	87.8	140,317
2	91.6	208,044	86.8	123,543	87.3	131,856	88.9	162,872	90.0	181,981	91.8	211,543
3	93.4	240,407	88.3	150,092	89.0	165,002	89.7	176,887	90.8	194,435	92.0	215,041
5	95.0	268,727	89.9	180,283	90.2	185,095	90.7	192,879	91.5	206,295	92.7	227,624
10	96.8	300,369	91.5	206,295	91.8	211,543	92.0	215,041	92.9	231,219	93.8	247,796
20	98.1	325,661	92.8	229,422	93.2	236,712	93.5	242,254	94.0	251,491	94.6	261,833
25	98.5	334,125	93.3	238,559	93.5	242,254	93.8	247,796	94.4	258,385	94.8	265,280
50	99.5	355,946	94.3	256,662	94.8	265,280	95.1	270,481	95.3	273,989	95.5	277,497
100	100.3	373,725	95.6	279,251	96.0	286,267	96.4	293,318	96.5	295,081	96.7	298,606

NOTE: Elevation - feet, NGVD.

TABLE 6-10
RECOMMENDED PLAN STAGE-FREQUENCY REDUCTIONS

Frequency Years	Base Conditions Stages (ft)	Recommended Plan Stages (ft)	Stage Reductions (ft)
Lower Ponding Area (Reach 1)			
1	87.0	87.0	0.0
2	91.0	87.8	3.2
3	92.9	88.5	4.4
5	94.6	89.6	5.0
10	96.3	91.2	5.1
20	97.6	92.7	4.9
25	98.0	93.0	5.0
50	99.2	94.4	4.8
100	100.3	95.7	4.6
Upper Ponding Area (Reaches 2, 3, and 4)			
1	87.8	87.8	0.0
2	91.6	88.9	2.7
3	93.4	89.7	3.7
5	95.0	90.7	4.3
10	96.8	92.0	4.8
20	98.1	93.5	4.6
25	98.5	93.8	4.7
50	99.5	95.1	4.4
100	100.3	96.4	3.9

TABLE 6-11
CURRENT YAZOO BACKWATER REPORT VERSUS
1982 YAZOO BACKWATER REPORT
RECOMMENDED PLANS
STAGE-FREQUENCY DEPARTURES

Frequency Years	2000 Report Recommended Plan 14,000-cfs Pump Elevation (ft)	1982 Report a/ Recommended Plan 17,500-cfs Pump Elevation (ft)	Difference (ft)
Lower Ponding Area (Reach 1)			
1	87.0	81.3	5.7
2	87.8	82.7	5.1
3	88.5	84.9	3.6
5	89.6	86.5	3.1
10	91.2	88.7	2.5
20	92.7	90.3	2.4
25	93.0	90.8	2.2
50	94.4	92.5	1.9
100	95.7	94.0	1.7
Upper Ponding Area (Reaches 2, 3, and 4)			
1	87.8	83.0	4.8
2	88.9	85.7	3.2
3	89.7	86.9	2.8
5	90.7	88.4	2.3
10	92.0	90.1	1.9
20	93.5	91.6	1.9
25	93.8	92.1	1.7
50	95.1	93.3	1.8
100	96.4	94.3	2.1

a/ Updated to 1943-1997 period of record (Plan 28, Array 3).

PUMP OPERATION DATA

54. The period-of-record routing results were used to develop the data required to determine the pump energy requirements. The data used to calculate the energy requirements included average head, average annual number of days of pump operation, and discharge duration. Table 6-12 shows the average annual number of days of pumping for each of the final array of alternatives.

Based on these data, the recommended pump based on energy requirements was a diesel-driven pump. Further refinements to the pump station will be evaluated in depth following the approval of the recommended plan.

TABLE 6-12
AVERAGE ANNUAL DAYS OF PUMPING FOR THE FINAL ARRAY OF ALTERNATIVES

Alternative	Average Annual Number of Days Pumped
Plan 3	63
Plan 4	44
Plan 5	31
Plan 6	24
Plan 7	12

RECOMMENDED PLAN PUMP OPERATION

55. As discussed earlier, the period of record routing models pump operation included 12 pumps at 1,167 cfs each with a pump on/off elevation of 87.0 feet, NGVD. The model operated the number of pumps based on the available storage above elevation 87.0 feet, NGVD; e.g., if the inflow was such that it required ten pumps, the model would turn ten pumps on automatically. The real time pump operation would use a forecast of Mississippi River stages, forecasts of inflows from the Steele Bayou and Sunflower River, and consideration of interior runoff conditions to determine requirements for pumping. Since the diesel-driven pumps cannot be instantaneously turned on at the same time, a pump operation scheme will be developed to achieve a pumping capability and flood control benefits commensurate with the benefits projected in the flood routings and benefit analysis. This may require some pumps to be turned on before landside stages reach elevation 87.0 feet, NGVD. Specific refinements to the pump operation sequence will be developed as part of the water control plan for the project.

STANDARD PROJECT FLOOD

56. The Standard Project Flood (SPF) represents the flood that can be expected from the most severe combination of meteorologic and hydrologic conditions that are considered reasonably characteristic of the geographic region involved, excluding extremely rare combinations. Procedures for estimating the SPF involve a single storm event--the Standard Project Storm (SPS). However, with base conditions, flooding in the Yazoo Backwater Area generally results from a number of storm events occurring over a period of several months.

57. Assuming a condition when the floodgates are closed and the SPF event occurs over the Yazoo Backwater Area, the inflows are of such magnitude that the 14,000-cfs pump station capacity is greatly exceeded and the interior ponding area would rise significantly where the floodgates would likely be operated for an extended period of time to evacuate the interior ponding for this headwater-type event. A similar but smaller event by comparison was the 1991 flood event, which was a headwater-type event with a low tailwater condition on the Mississippi River.

58. Should this condition occur with a high Mississippi River tailwater and an SPF event over the Yazoo Area, the pump would shorten the duration of the rising leg of the hydrograph and slightly reduce the peak stage. The extent and magnitude of flooding with the SPF would not be greatly affected by the 14,000-cfs pump station because the storm was a very intense, short duration event with inflow rates much in excess of the pump capacity.

HYDRAULIC DESIGN

INLET AND OUTLET CHANNELS

59. A portion of the inlet and outlet channels was completed by contract in 1986 prior to the cancellation of the project funding. The inlet and outlet channels were constructed with the exception of the portion that crosses Highway 465. Upon approval of this project, the portion of the inlet and outlet channels that has not been constructed will be reevaluated for stone protection and approach discharge apron for the 14,000-cfs recommended pump station. The cost required to finish construction of the inlet and outlet channels have been included in the cost estimate.

PUMP DESIGN

60. The pump station was designed and modeled prior to the cancellation of the project funding in 1986 and will be reevaluated for the 14,000-cfs recommended pump station. Reference Technical Report HL-88-2, "Pumping Station Inflow-Discharge Hydraulics, Generalized Pump Sump Research Study," U.S. Army Engineer Research and Development Center (ERDC) (formerly the U.S. Army Engineer Waterways Experiment Station), February 1988.

ENVIRONMENTAL ANALYSES

61. Data were developed from the period-of-record routing output to support the environmental analyses required to assess the impact of the recommended plan on the Yazoo Backwater Area. The 2-year frequency flood area was agreed upon by all involved to be the flooded area that was

critical to the waterfowl, fisheries, and terrestrial habitat. Stage-frequency, stage-duration, and stage-area data were used to compute the data required to analyze the waterfowl, fisheries, and terrestrial habitat. Plates 4-24 and 4-25 show the base conditions stage-duration and the Recommended Plan stage-duration curves, respectively.

WATERFOWL

62. The waterfowl habitat was analyzed by using a computer program, ENV-DUC1.EXE, which looks at the period-of-record computed stage output data and by specifying certain conditions will compute average annual duck acres. The conditions that were used to analyze the waterfowl habitat in this area were a timeframe from 1 November to 28 February and a maximum depth of 1.5 feet for feeding habitat. The period-of-record used was from 1943 to 1997. The average daily duck acres (acres with depths less than 1.5 feet) computed for Base Conditions and the Recommended Plan can be seen in Table 6-13.

TABLE 6-13
COMPUTED DUCK ACRES

Reach	Base Conditions (acres)	Recommended Plan (acres)
1	4,640	4,347
2	2,179	2,137
3	2,556	2,505
4	2,532	2,447

FISHERIES

63. The fisheries habitat was analyzed by using a computer program, ENV-FSH1.EXE, which uses the period-of-record 2-year computed stage output data and by specifying certain conditions

will compute average daily fish acres. The conditions that were used to analyze the fisheries habitat in this area was to determine acres within a timeframe from 1 March to 30 June, maximum depth of 10 feet, a minimum depth of 1.0 foot, and an 8-day minimum continuous duration. The period-of-record was from 1943 to 1997. The average seasonal fish acres (acres which fit all of the above criteria) computed for Base Conditions and the Recommended Plan are shown in Table 6-14.

TABLE 6-14
COMPUTED FISH ACRES

Reach	Base Conditions	Recommended Plan
1	47,426 rearing acres	42,363 rearing acres
	24,270 spawning acres	21,534 spawning acres
2	22,867 rearing acres	19,578 rearing acres
	13,851 spawning acres	11,230 spawning acres
3	34,075 rearing acres	30,441 rearing acres
	20,278 spawning acres	16,774 spawning acres
4	24,645 rearing acres	21,558 rearing acres
	13,917 spawning acres	11,780 spawning acres

NOTE: Rearing acres - total average daily acres.
Spawning acres - acres with a duration of flooding greater than or equal to 8 days.

TERRESTRIAL

64. The terrestrial habitat was analyzed by using the average annual acres flooded for at least 90 days (25 percent duration) and the minimum number of forested acres flooded continuously between March and May.

LAND USE AND FLOOD DELINEATION

65. Reforestation of lands below elevation 87.0 feet, NGVD, in the lower delta area is a nonstructural flood damage reduction feature of the Recommended Plan that was analyzed using the computer program, ARCVIEW GIS (version 3.2). Digital maps for the lower delta area and the land classifications (CRP lands, WRP lands, WMA's, etc.) provided by the U.S. Fish and Wildlife Service (FWS) were mapped in detail. The FLOOD IMPACT ASSESSMENTS spatially oriented computer program routine (developed by ERDC, 1999) was used in the ARCVIEW GIS computer program to map the actual location of cleared lands to be reforested and determine the number of acres for all land classifications. These data were closely coordinated with FWS personnel involved on this project.

66. Plate 4-26 shows the 1-year frequency flood delineation for Base Conditions and the Recommended Plan. Plate 4-27 shows the 2-year frequency flood delineation for Base Conditions and the Recommended Plan. Plate 4-28 shows the 10-year frequency flood delineation for Base Conditions and the Recommended Plan. Plate 4-29 shows the 100-year frequency flood delineation for Base Conditions and the Recommended Plan. Plate 4-30 shows the flood delineation for the nonstructural unprotected areas below elevation 87.0 feet, NGVD, (pump on/off elevation) and the structurally protected areas above 87.0 feet, NGVD. Plate 4-31 shows the Base Conditions 1-year frequency land classifications. Plate 4-32 shows the Base Conditions 2-year frequency land classifications. Plate 4-33 shows the Base Conditions 10-year frequency land classifications. Plate 4-34 shows the Base Conditions 100-year frequency land classifications. Plate 4-35 shows the Recommended Plan 1-year frequency land classifications.

Plate 4-36 shows the Recommended Plan 2-year frequency land classifications. Plate 4-37 shows the Recommended Plan 10-year frequency land classifications. Plate 4-38 shows the Recommended Plan 100-year frequency land classifications.

WETLAND HYDROLOGY

67. Wetland Hydrology Background is as follows:

a. Hydrology creates and maintains all wetlands.

b. Joint EPA/COE wetlands definitions: Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for a life in saturated soils conditions.

68. EPA/Corps Criteria for Wetland Hydrology are as follows:

a. An area may have wetland hydrology if it is inundated or saturated to the surface for at least 5 percent of the growing season in most years.

(1) "In most years" means at least 50 years out of 100, or 50 percent probability in any 1 year (2-year frequency with duration sufficient to support wetlands vegetation).

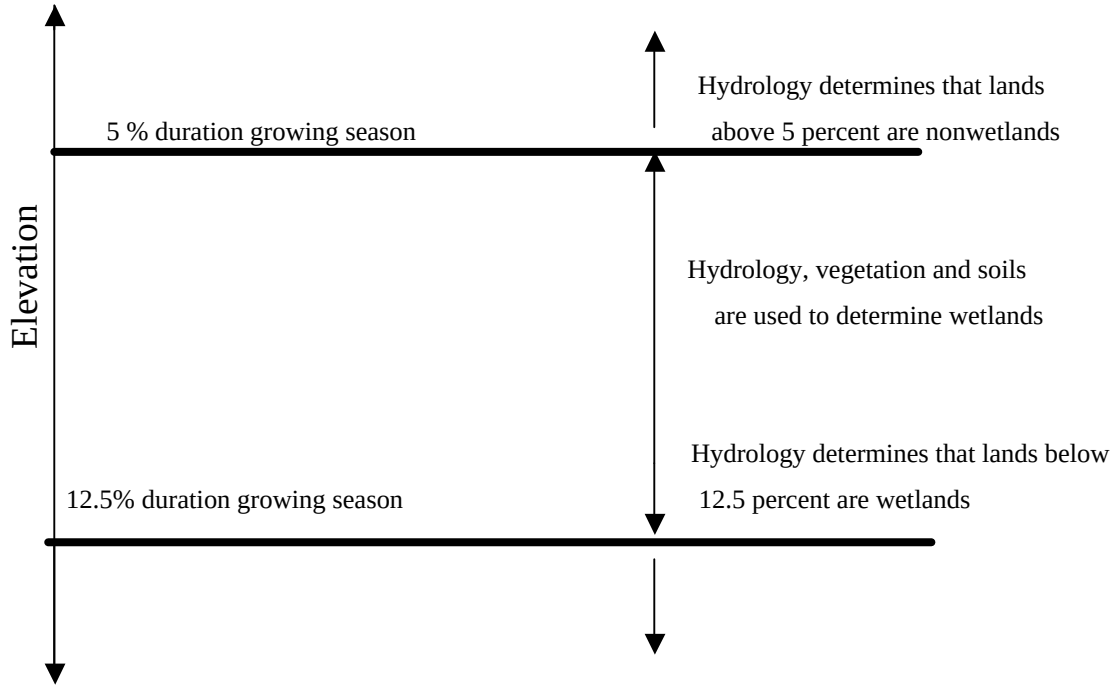
(2) The growing season is defined as the portion of the year when soil temperature (measured 20 inches below the surface) is above biological zero (5 degrees C or 41 degrees F). In the absence of data on soil temperature, growing season can be estimated from data given in most Natural Resources Conservation Service county soil surveys. Starting and ending dates generally are based on the 28 degrees F air temperature thresholds for the average year.

(3) The minimum 5 percent duration refers to a single, continuous episode of inundation.

(4) Growing season for Vicksburg was determined from NRCS data from the website ftp://ftp.wcc.nrcs.usda.gov/support/climate/wetlands/ms/28149.txt. Computed growing season was the period 3/1 to 11/27 (270 Days X 5% = 13 days).

b. ERDC Technical Report Y-87-1 (Corps Wetlands Delineation Manual). Areas that are irregularly inundated or saturated less than 5 percent of the growing season continuously are not wetlands. Areas that are inundated or saturated irregularly more than 12.5 percent of the growing season continuously are wetlands. Areas that are inundated or saturated between 5 and 12.5 percent of the growing season continuously may or may not be wetlands. In the analysis of wetlands in this study, the conservative assumption was made that lands inundated continuously more than 5 percent of the growing season would be classed as wetlands.

69. Schematic depicting Wetland Determination is as follows:



70. NRCS wetland definition is given below:

a. Areas that have a predominance of hydric soils and that are inundated or saturated by surface water at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of hydrophytic vegetation typically adapted for life in saturated soils conditions. To be a farmed wetland, it must be inundated at least 15 consecutive days during the growing season in most years.

b. Key features of this definition are:

(1) Hydrophytic vegetation

(2) Hydric soils

(3) Wetland hydrology

(4) All three must be present for an area to be considered a wetland; however, past studies have shown that wetland hydrology is the control which depicts wetlands, particularly when evaluating inundation for 5 percent of the growing season.

71. Table 6-15 shows the comparison of the Base Conditions maximum annual peaks versus the maximum wetlands peak data developed by using the WETSORT computer program. Plate 4-39 shows the Jurisdictional Wetlands. Plate 4-40 shows the Base Conditions 100-year frequency and FWS future converted projections. Plate 4-41 shows the Total Farmed Wetlands. Plates 4-42 through 4-45 show the Monthly Flood Control Impacts and the Monthly Hydrological Restoration Impacts. Plates 4-42 through 4-45 were developed to show the monthly differences in peak stages for each year of the period of record analyzed to better understand the flood control impacts and hydrological restoration impacts. These were used extensively in coordination with FWS.

TABLE 6-15
BASE CONDITIONS MAXIMUM ANNUAL AND WETLAND PEAKS

YEAR	BASE CONDITION MAX ANNUAL PEAK	DATE MAX OCCURRED (MONTH/DAY)	BASE CONDITION MAX WETLANDS PEAK	DATES MAX WETLANDS OCCURRED
1973	100.3	5/23	99.7	5/14 - 5/27
1945	96.9	5/5	96.4	4/27 - 5/10
1950	96.0	3/11	95.4	3/2 - 3/15
1979	95.7	5/6	95.1	4/29 - 5/12
1983	95.8	6/11	95.0	6/1 - 6/14
1944	95.3	5/17	94.5	5/10 - 5/23
1974	95.3	2/10	90.2	6/15 - 6/28
1975	95.3	4/20	94.5	4/11 - 4/24
1949	94.0	3/7	92.9	3/1 - 3/14
1984	93.7	6/2	92.9	5/23 - 6/5
1993	93.6	5/20	93.0	5/12 - 5/25
1997	93.6	4/7	92.8	3/29 - 4/11
1994	93.5	5/11	92.8	5/4 - 5/17
1991	93.0	1/28	90.6	4/30 - 5/13
1946	92.4	1/30	83.8	3/30 - 4/12
1980	92.4	4/14	92.0	4/12 - 4/25
1948	92.2	4/22	91.8	4/19 - 5/2
1961	92.1	4/6	91.2	3/30 - 4/12
1990	92.0	3/4	88.6	3/1 - 3/14
1962	91.6	4/25	91.1	4/19 - 5/2
1970	91.2	5/17	90.0	5/9 - 5/22
1955	91.1	4/9	89.8	4/1 - 4/14
1989	90.4	3/14	89.6	3/9 - 3/22
1996	90.3	6/23	89.4	6/13 - 6/26
1952	90.2	4/18	89.3	4/13 - 4/26
1995	90.2	6/27	89.3	6/16 - 6/29
1958	89.8	5/22	89.0	5/15 - 5/28
1971	89.8	3/16	87.6	3/9 - 3/22
1972	89.8	12/31	86.4	5/6 - 5/19
1943	89.7	4/11	87.7	4/3 - 4/16
1969	89.7	2/24	86.2	4/27 - 5/10
1951	89.4	4/16	88.8	4/12 - 4/25
1964	89.0	4/4	87.4	3/27 - 4/9
1968	88.7	4/16	86.9	4/9 - 4/22
1987	88.5	3/16	85.6	3/9 - 3/22
1985	88.4	3/30	87.1	3/22 - 4/4
1957	88.3	5/2	86.7	4/25 - 5/8
1963	87.8	4/13	86.8	4/2 - 4/15
1965	87.7	5/2	86.5	4/22 - 5/5
1988	87.4	1/8	79.7	4/11 - 4/24
1956	87.3	3/3	83.9	2/29 - 3/13
1978	86.9	5/26	85.8	5/19 - 6/1
1966	86.3	3/1	84.2	5/9 - 5/22
1986	86.1	12/21	77.9	11/10 - 11/23
1967	85.3	5/29	82.1	5/22 - 6/4
1992	85.2	12/31	79.1	3/20 - 4/2
1953	84.9	5/27	82.4	5/20 - 6/2
1976	84.8	3/8	83.3	3/4 - 3/17
1959	83.5	3/2	76.4	3/2 - 3/15
1960	83.4	4/29	80.3	4/19 - 5/2
1981	82.7	6/2	79.8	6/11 - 6/24
1977	82.5	4/20	78.8	3/12 - 3/25
1954	75.3	5/8	72.6	5/6 - 5/19

EFFECTS OF RECOMMENDED PLAN

Mississippi River and Yazoo Backwater Flood Stages

72. In the 1982 analysis and subsequent design analysis, the impact of a large pumping plant (25,000 cfs) on Mississippi River stages was evaluated by use of the Mississippi Basin Model, which was calibrated to 1973 conditions. Flood hydrographs for the 1973 and 1975 floods were introduced and stage hydrographs were recorded at stations on the Lower Yazoo and Mississippi Rivers for various conditions including preproject (no backwater levees), existing (levees and floodgates only), and the recommended 25,000-cfs pumping plan. The tests indicated a maximum increase of about 0.4 foot in riverside stages with the 25,000-cfs station in continuous operation. With the recommended 14,000-cfs pumping plant, the increase would be much smaller than with the 25,000-cfs station as tested. The effect was found to diminish downstream of Vicksburg.

73. From the routing results and rating curves, it is estimated that the maximum increase in peak stages with the 14,000-cfs pump would be about 0.25 foot for conditions near initial pump start-up elevation which are still below major damage levels for developmental areas. Once Mississippi River levels rise to overflow the Yazoo River banks, the impacts of pumps will be minimal.

Navigation

74. The Recommended Plan will not impact any stages on the Yazoo River for river stages below 87.0 feet, NGVD. Therefore, the navigation depth under low-flow conditions would not

be impacted. The pump outlet channel was designed to minimize crosscurrents in the navigation channel when the pump station would be operating. Reference Technical Report HL-90-4, "Yazoo Backwater Pumping Station Discharge Outlet," ERDC, May 1990.

Sedimentation

75. During certain prolonged periods when the pumps are not in operation and river stages are at moderate levels (80-87 feet), some minor sedimentation is expected to occur in the approach to the inlet channel of the pumps and in the outlet channel near the confluence with the Yazoo River. While sedimentation is not expected to be of any major concern, the control of vegetation in the deposited areas will need to be pursued possibly on an annual basis. It is likely after the project is complete, that removal of sediment accumulations (averaging about 1 foot in depth over the extent of the channels which is approximately 80,000 cubic yards) once or twice in the life of the project may be necessary depending upon the sequence of hydrologic events which could result in deposition in the channels as described above. Material deposited in the outlet channel by the secondary currents of the Yazoo River may be returned to the Yazoo River without any significant impacts. That material deposited in the inlet channel will likely be disposed in upland areas available within the pumping plant property.

Channel Stability

76. With the Recommended Plan, the water surface slope in the existing connecting channel will be slightly steeper than base conditions. However, during the most severe conditions indicated by the period-of-record routings, the channel velocity would be less than 4 feet per second, and no channel stability problems are anticipated.

SECTION 3 - GEOTECHNICAL

GENERAL

77. The Yazoo Backwater Reformulation Study provides a detailed evaluation of geotechnical conditions at the project and reevaluation of the selected plan. The two main alternative plans include a pumping plant alternative (with various sizes to be evaluated) and levees along the Big Sunflower and Little Sunflower Rivers. The purpose of this geotechnical portion of the study is to give a preview of the geology and soil types to be encountered and to provide sufficient geotechnical design input so as to properly evaluate each alternative and for cost estimating purposes.

SCOPE OF WORK

78. Geotechnical evaluations, including review of available soils information, geologic maps, previous reports, and field investigations, were performed to evaluate the geotechnical concerns for the different alternatives. Evaluation of the levee alternative required extensive field investigations, as very little soils information was available. Field investigations along the proposed levee alignment and at each of the proposed structure sites (approximately 75) were performed utilizing the cone penetration test (CPT). The CPT is a method of obtaining in situ soils information including soil type, stratigraphy, and soil strength. Approximately 87 CPT tests were performed to obtain the required soils information and stratification of the levee foundation. Design analyses included slope stability to evaluate the stability of the recommended levee section and seepage analyses to determine the need for and location of seepage berms. Soils information concerning the levee alternative will not be presented in this report. Soils information and design of the pumping plant were performed previously and published in various Design Memorandums (DM) in the 1970's and 1980's. No additional field

investigations or geotechnical design analyses were necessary in this study. Since the pumping plant is the recommended alternative, the remainder of this report will deal exclusively with the geotechnical considerations for the pumping plant. The information presented is based on published geologic reports, borings made for site selection and presented in DM No. 18, borings made for the general design and presented in DM No. 20, and borings drilled subsequent to the GDM and presented in Supplement No. 1 to GDM No. 20.

FOUNDATION EXPLORATION

SITE SELECTION

79. The initial field explorations for this project consisted of 79 borings taken for and presented in DM No. 18, Site Selection. The borings were taken during the period September 1983 to February 1984. Five piezometers were installed during this phase of field exploration to monitor ground-water fluctuations in the alluvial aquifer.

GENERAL DESIGN

80. Foundation explorations during the general design phases, and published in GDM No. 20, consisted of 22 borings taken during the months of June, August, and September 1984.

SUPPLEMENT NO. 1 TO DM NO. 20

81. Geotechnical explorations presented in Supplement No. 1 to DM No. 20 consisted of 61 borings taken at the site during the period November 1984 to June 1986. These borings were drilled to serve as the basis for the detailed geotechnical design and are prefixed YPS.

FIELD METHODS

82. All borings were obtained using the rotary drilling method with drilling mud. Undisturbed samples in clays and silts were secured using a 5-inch I.D. vacuum type Shelby tube sampler or a Hvorslev (fixed piston) sampler. General samples were obtained in sands using a 2.5-inch-diameter drive tube or 2.5-inch-diameter split spoon sampler. Standard Penetration Test blow counts, or N-values, were recorded during the advancement of the split spoon sampler. Graphic logs of the borings taken during the Site Selection and General Design phases are shown in DM Nos. 18 and 20. Graphic logs of the borings taken for the geotechnical design (prefixed YPS), as well as six previously published borings which fall within the protected area, are shown on Plates III-2 through III-15 of Supplement No. 1 to DM No. 20. Selected electric logs for borings made during the site selection and General Design phases are published in DM Nos. 18 and 20.

LABORATORY INVESTIGATIONS

83. Laboratory tests consisting of visual classification, water content determination, Atterberg Limits, grain-size analyses, and unconfined compression (UC) tests were performed by the Vicksburg District Soils Laboratory. The Mississippi Valley Division Soils Laboratory performed unconsolidated-undrained (Q) triaxial and consolidated-drained (S) direct shear tests and one-dimensional consolidation tests. The consolidation, UC, Q, and S tests were performed on representative clay samples only. Test data summaries and individual test data sheets are presented on Plates III-17 through III-52 of Supplement No. 1 to DM No. 20.

REGIONAL GEOLOGY

PHYSIOGRAPHY-TOPOGRAPHY

84. The Yazoo Backwater Pumping Plant site is located near the southern limits of the Yazoo Basin, a subprovince of the Mississippi Alluvial Valley. The Yazoo Basin is bounded on the west by the Mississippi River and on the east by the Bluff Hills. The surface of the Yazoo Basin consists mainly of an intricate network of meander belt (point bar, abandoned channel, and natural levee) deposits. The point bar deposits, which form the ground surface at the pumping plant site, exhibit an undulating surface of ridges and swales partially covered by remnant natural levees. Natural ground surface elevations in the vicinity of the pumping plant range from approximately 55 feet, NGVD, at Centennial Lake, to more than 100 feet, NGVD, along the base of the Bluff Hills where elevations increase abruptly to 300 feet, NGVD, on the top of the Bluff Hills.

STRATIGRAPHY

85. The geologic formations present at the project site consist of the Quaternary alluvium, underlain by the Eocene Yazoo Formation. The alluvium is divisible into topstratum deposits, which overlay substratum deposits. The topstratum consists of fine-grained silts, clays, sandy silts, and silty sands deposited by vertical accretion. The substratum is comprised of a thick deposit of fine sands that grade downward to coarse sands and sandy gravel. Lenses of silty sands and clays are occasionally encountered in the substratum. The contact between the topstratum and substratum is highly irregular and reveals channels of topstratum incised into the substratum. The substratum overlies the eroded surface of Tertiary formations within the Mississippi Alluvial Valley. In the project area, the substratum overlies the Yazoo Formation of the Jackson Group. The Yazoo Formation consists of highly plastic, impervious montmorillonitic clay. This formation is a regional aqualude.

STRUCTURE

86. The project area is situated about 25 miles west of the structural axis of the Mississippi Embayment. Much of the Mississippi Embayment is underlain by extensions of the Ouachita Mountain fold belt of Paleozoic age. Numerous major structures; i.e., fault systems, basins, uplifts, etc., of various ages lie, or partially lie, within the Mississippi Embayment, however, not within the project area. The established trace of the Pickens-Gilbertown Fault System extends from Gilbertown, Alabama, through Pickens, Mississippi, and terminates near the axis of the Mississippi Embayment approximately 30 miles northeast of the study area. The project area is situated a few miles southwest of the Monroe Uplift-Sharkey Platform, along the west limb of the structural embayment, where the formational dip is to the southeast. Surficial evidence of a northwesterly trending fault exists along Bluff Creek, in the Bluff Hills, approximately 4 miles north of Vicksburg and is referred to as the Bliss Creek Fault. The Bliss Creek Fault is reportedly Tertiary in age; i.e., only the Tertiary deposits have been disturbed, whereas the overlying Plio-Pleistocene deposits have not been disturbed. This observation indicates that movement along the fault has not occurred since Tertiary time. The northwesterly extent of the Bliss Creek fault is not known because the Tertiary surface is covered by more than 100 feet of alluvium. A straight line northwesterly projection of the fault from Bliss Creek places the fault trace about 1 mile northeast of the project site. The questionable extent of the fault, the apparent inactivity of the fault since Tertiary time, and the fact that the Tertiary surface is covered by more than 100 feet of alluvium in the area of the site, are considered sufficient reasons for dismissing the Bliss Creek Fault as a threat to the project.

TECTONICS AND SEISMOLOGY

87. The New Madrid earthquakes of 1811-1812 are generally considered to be the most powerful earthquakes in United States history and were rated approximately XI on the Modified Mercalli (MM) scale, and had a body-wave magnitude of approximately 7.2. Subsequent record keeping and more recent seismic monitoring show that the New Madrid area continues to be an

active earthquake area. During the 1950's, more than ten earthquakes were recorded in the New Madrid area, with intensities of MM of V or VI. The numbers and intensities were similar during the 1960's and 1970's. Record keeping and seismic monitoring led to the development of earthquake zones across the United States, relative to occurrences and intensities of the earthquakes. The generally accepted southern limit of the New Madrid earthquake zone lies near Marked Tree, Arkansas, northwest of Memphis, Tennessee (about 225 miles from the project site). In the area of the project site, earthquakes should be infrequent and of low intensity if they occur. It is recommended that 0.025g seismic coefficient be used for design purposes involving pseudo static analysis (Engineer Regulation (ER) 1110-2-1805, 30 April 1977 or Engineer Manual (EM) 1110-2-1902, 27 December 1960, Change 1).

HYDROGEOLOGY

88. The entire project area is ultimately drained by the Mississippi River, which also bounds the region on the west and south. The Yazoo River, locally occupying an abandoned course, traverses the area from the northeast to the southwest and enters the Mississippi River at Vicksburg. The Yazoo River drains most of the study area and forms the southern boundary of the project site. The fine-grained topstratum overlies the more permeable sands and gravels of the substratum. The hydraulic connectivity of the topstratum and substratum is dependent on the thickness, lenticularity, and permeability of the topstratum material. Permeable sandy lenses that are overlain and underlain by clay should be considered as hydraulically connected to the substratum during high water, and may develop perched water table conditions at low water stages. Piezometers indicate that the water table, as measured by the pressure head in the alluvial aquifer, fluctuates considerably and is primarily controlled by the stages on Steele Bayou and the Yazoo River. It is anticipated that a water table elevation above 100 feet will exist when the Yazoo River stage is at the project flowline of 107 feet.

SITE GEOLOGY

GENERAL

89. The Yazoo Backwater Pumping Plant site is located in the alluvial valley of the Mississippi River approximately 8 miles north of Vicksburg. Ground surface elevations vary from 79 to 91 feet, NGVD, and average 85 feet, NGVD. An interpretation of the local geology is presented in ERDC Technical Report 3-480, "Geological Investigations of the Yazoo Basin" (Vicksburg Quadrangle) by F. L. Smith, 1979 (Plate 4-58). Alluvial sediments are generally divisible into a fine-grained upper unit called the topstratum and a coarse-grained lower unit called the substratum. Technical Report 3-480 further classifies topstratum sediments based on their environment of deposits. Each category of sediments contains a suite of material types whose engineering properties vary within known limits. The topstratum deposits present at the pumping plant site are point bar in origin. Point bar topstratum is deposited on the inside of river bends as a result of meandering of the stream. Point bar deposits consist of an alternating series of ridges and swales. Ridges are elongated silty sandy bars deposited during high river stages. Swales are fine-grained deposits which accumulate between ridges during falling river stages.

TOPSTRATUM

90. Investigative borings revealed the following subsurface conditions. Point bar topstratum thickness ranges from 13 to 63 feet and averages 37 feet. The topstratum is composed primarily of silt (ML) and silty sand (SM, SP-SM) with subordinate amounts of clay (CH-CL). The silt (ML) is generally gray with sand, silty sand, and clay strata. The silty sands (SM, SP-SM) are brown, fine-grained and contain occasional clay strata. The clays are gray and brown, range from medium to hard in consistency, and contain silt strata, sand strata, and roots. Excavation for the pumping plant structure will extend through the topstratum materials to approximately

elevation 50 feet, NGVD. Plates 4-59 and 4-60 show the relationship between the geology and the structural excavation along the pumping plant and approach channel centerlines.

SUBSTRATUM

91. Four of the exploratory borings penetrated through the quaternary alluvium and into the underlying Yazoo Formation. These borings show that the substratum extends to an average elevation of -57 feet, NGVD, and has an average thickness of 103 feet. The substratum is composed of gray sand (SP) with subordinate amounts of silty sand (SM) and silty fine sand (SP-SM). The sand is fine to medium and contains occasional silt strata, lignite, silty sand strata, and a trace of gravel. This unit will form the foundation for the structure and will require dewatering prior to excavation.

TERTIARY

92. The alluvial sediments are underlain by the Yazoo Formation of the Jackson Group. This formation consists of greenish-gray plastic clay (CH) with silt strata or lenses and scattered shell fragments. This formation is a barrier to ground-water migration (aqualude) and underlies the entire site.

ENGINEERING CONSIDERATIONS

GENERAL

93. Detailed design is beyond the scope of this report; however, design of the Yazoo Backwater pump was previously performed and results presented in DM No. 20 (April 1985) and in Supplement No. 1 to DM No. 20 (June 1987). No additional design analyses on the pump alternative were performed in this reformulation study. A detailed review of the borings and the

design analysis of DM No. 20 and Supplement No. 1 was performed. The following observations from that review are presented below as engineering considerations.

CHANNEL SLOPES, EXCAVATION SLOPES, COFFERDAM, AND STRUCTURE SLOPES

94. Borings indicate there are no thick clay swales present at the site. Areas that have no clay in the topstratum are present in the inlet channel and structure area. Excavation of the inlet channel, structure area, and some of the outlet channel will expose substratum sands which are highly erodible. Riprap or other bank protection will be required on the channel slopes. Slope stability analyses presented in DM No. 20 indicate all slopes are safe with greater than 1.3 factors of safety against sliding along deep-seated failure planes.

FOUNDATION SETTLEMENT

95. The foundation for the pumping plant will be located in point bar deposits. The founding elevation of the structure will place the foundation in clean to silty sands. Based on a review of the SPT blow counts, the structure will not require piles and can be soil founded with only minimal settlement expected. Overexcavation and backfilling and compacting with clean sand may be used in areas under the structure to remove any questionable, fine-grained materials that may exist close to the finished grade.

DEWATERING

96. The thickness and permeability of the substratum sands indicate the need of an extensive dewatering system during construction of the pumping station. DM No. 20 contains a comprehensive dewatering analysis that includes both a deep well design and a slurry trench design. A field pumping test was completed at the site in 1984.

UNDERSEEPAGE AND GROUND-WATER CONTROL

97. Detailed underseepage analyses were performed and the results presented in DM No. 20. Steele Bayou and Little Sunflower structures also required underseepage analyses due to the increased differential heads which will occur after completion of the pumping plant as the water level will be reduced by the pumping of the ponding area. Seepage analyses of the two structures included examination of the piezometer data at both sites. The piezometer data indicate filters in the inlet channel(s) may have become clogged during their operation. This condition has a significant impact on the results of the analyses. Review of soils data at the pumping plant site indicates that piping could develop in the inlet channel due to concentrated underseepage into the inlet channel. Analyses indicate inadequate factors of safety against piping for all three structures when relief of the underseepage heads in the inlet channel areas of these structures is impaired. At Steele Bayou and Little Sunflower structures, inlet channel relief appears to be impaired. This impairment is best attributed to siltation of the riprap and filters. It is suggested that relief wells be installed at the structures. Relief wells also provide the added benefit of hydrostatic uplift relief which improves the structures safety against overturning and uplift. The structure length of the proposed Yazoo Backwater Pumping Plant provides adequate safety factors against piping in the inlet channel when underseepage relief is not impaired. However, the possibility exists that impaired seepage relief could result from siltation in the future as it has at other sites. Therefore, it is recommended that relief wells be included at this site to provide a positive means of pressure relief. The dewatering wells required for construction will be designed such that they function as relief wells after construction is complete.

CONSTRUCTION MATERIALS

98. Materials that will be required during construction of the project are (1) clays for compacted impervious backfills, (2) silts and clays for random fills, (3) sands and gravels for concrete aggregate, (4) crushed stone for coarse concrete aggregate, and (5) riprap for paving of inlet and outlet channel slopes. Clays, silts, and sands can be obtained from excavated materials and nearby borrow sources. Sources for gravels, aggregates, and riprap will be presented in future design documentation and the construction plans and specifications.

99. Final design may require additional field investigation and will require more detailed design analyses. These studies do, however, indicate that geologic or geotechnical conditions which would have serious adverse effects on this project do not exist.

SECTION 4 - DESCRIPTION OF PROPOSED PROJECT DESIGN

GENERAL

100. The structural flood control alternatives investigated for the project included several pumping plant alternatives and a levee alternative. The pumping plant alternatives included a pump station with pumping capacities ranging from 10,500 to 24,000 cfs and various pump operational stages and water management elevations and with electric motors and diesel engines as the pump prime mover. The energy analysis for the pumping plant is presented later in this section. The levee alternative included numerous structures ranging in size from a single pipe

conduit to a multicell box culvert with a reinforced concrete inlet structure and gated outlet structure. The structural, mechanical, and electrical quantities for all alternatives were developed and are reflected in the cost estimates.

101. The recommended plan presented in this report (see Plate 4-46) provides for the construction of an inlet channel, an outlet channel, a pumping plant with all appurtenant structures, and site work. The pumping plant will be located approximately 3,000 feet west of Steele Bayou structure and approximately 1,200 feet north of Highway No. 465. The pumping plant will be constructed of reinforced concrete and will consist of an approach apron, flood walls, retaining walls, approach monoliths, pump bay monoliths, a gantry deck, and a discharge apron.

102. The pumping plant will tie in with the existing backwater levee by means of new levee construction and floodwalls. In order to retain the backfill and maintain stable slopes, retaining walls will be required at the inlet and outlet abutments of the pumping plant. Preliminary structural designs for an electric-operated pumping plant were performed to develop a conceptual plan and were presented in a separate design memorandum, "FC/MR&T, Yazoo Basin, Yazoo Backwater Pumping Plant, Design Memorandum No. 20," April 1985, and "Supplement No. 1 to Design Memorandum No. 20," June 1987. The quantities from these reports were utilized to develop the cost estimate for the electric operated pumping plant. Following approval of the above supplement, North Pacific Division initiated design on a Feature Design Memorandum. Even though work on the Feature Design Memorandum was terminated, sufficient work was completed to substantiate the GDM level designs. The quantities for the electric operated pump plant were adjusted to accommodate the diesel operated pump plant including fuel storage and distribution. The final structural designs of the pumping plant will be presented in the Design Documentation Report which will be developed concurrently with the plans and specifications. The design criteria for the channels were prepared as a separate report, "Yazoo Backwater Project, Yazoo Backwater Pumping Plant, Channel Work Report," February 1985, and approved

in a design conference held 5 March 1985 and completed in 1987. Based on this report, plans and specifications were prepared, and a channel work contract was awarded on 25 March 1986. This contract allowed for the construction of a portion of the inlet and outlet channels, the cofferdam, an interim levee, and a storage area as shown on Plate 4-47. There was approximately 885,500 cubic yards of material excavated from the inlet and outlet channels under the channel work contract. Approximately 995,500 cubic yards of material remains to complete the inlet and outlet channels which does not include excavation of any silt that has accumulated in the channels since the completion of the channel work contract. Even though the channel contract was designed for a 17,500-cfs station, it is sufficiently flexible to accommodate a smaller pumping plant. A description of the revised 14,000-cfs pumping plant, appurtenant structures, channels, and site work is furnished in the following paragraphs.

DESCRIPTION OF CHANNELS AND SITE WORK

INLET CHANNEL

103. The inlet channel will connect the pumping plant to Steele Bayou and the connecting channel as shown on Plate 4-46. The inlet channel will be approximately 3,200 feet long with an estimated bottom width of 300 feet from Steele Bayou to Station 10+00U and then transition to a width of approximately 346 feet at Station 5+00U. The inlet channel will have a bottom elevation of 60 feet, NGVD, and side slopes of 1 on 4. The inlet channel will be protected by 18 inches of riprap for the first 100 feet upstream of the approach apron. For additional information, see Plate 4-48.

OUTLET CHANNEL

104. The outlet channel will connect the pumping plant to the Yazoo River as shown on Plate 4-46. The outlet channel will be approximately 4,000 feet long with a bottom width of

approximately 346 feet until Station 5+00D and then transition to a width of 290 feet at Station 10+00D. The outlet channel will have a bottom elevation of 68 feet, NGVD, and side slopes of 1 on 4. The outlet channel is protected by 24 inches of riprap for the first 200 feet downstream of the discharge apron and by 18 inches of riprap for the next 1,300 feet. For additional information, see Plate 4-48.

SITE WORK

105. All impervious material taken from the channel and structural excavation will be used in the cofferdam, new levee construction, and structural backfill. Due to a shortage of impervious material in the channels, it will be necessary to borrow impervious material from the disposal areas shown on Plate 4-46. Any excavated materials not required for construction will be placed within the disposal areas or stockpiled for future use. A portion of upstream disposal area No. 2 will be compacted and capped with a clay blanket. This storage area will provide sufficient room to store maintenance equipment, and any other storage facilities, if required. For a detailed description of the disposal areas and storage area, see the "Yazoo Backwater Project, Yazoo Backwater Pumping Plant, Channel Work Report," February 1985. The new levee will tie into the existing Yazoo Backwater levee approximately 1,400 feet west of Steele Bayou structure. From this point, the new levee will extend approximately 1,400 feet parallel to the centerline of the channel before turning 90 degrees and extending approximately 500 feet to tie into the east abutment of the pumping plant. This 500-foot segment of the levee will have a 45-foot crown width in order to accommodate visitor parking. The new levee will then extend from the west abutment of the pumping plant and tie back into the Yazoo Backwater levee approximately 3,800 feet west of Steele Bayou structure. There will be 50-foot berms between the toes of the new levee sections and the ends of the pumping plant. An access road will provide access from Highway No. 465 to the pumping plant as shown on Plate 4-46. See paragraph entitled "Access Roads" for further discussion of the access roads.

STEELE BAYOU AND LITTLE SUNFLOWER STRUCTURES

106. The Steele Bayou and Little Sunflower structures were evaluated for a range of water management elevations from 70.0 to 90.0 feet, NGVD, with a tailwater elevation of 60 feet, NGVD, and were found structurally adequate. No structural or mechanical modifications of either of these structures will be required for water management elevations at or below elevation 80.0 feet, NGVD. However, structural and mechanical modifications will be required for both structures for water management elevations above elevation 80.0 feet, NGVD.

DESCRIPTION OF STRUCTURES

FLOODWALLS

107. The pumping plant will tie into the new levee segments by means of floodwalls as shown on Plate 4-49. The floodwalls will consist of an inverted T-type reinforced concrete floodwall and a cantilever I-type sheet pile wall. The floodwalls will have an overall length of approximately 136 feet with a top elevation of 119.0 feet, NGVD. The T-type floodwalls will be soil founded and will have steel sheet pile cutoffs. The I-type wall is a vertical wall consisting of a row of deeply embedded steel sheet pile capped by a reinforced concrete section. The floodwalls will be founded on compacted clay fill. The east floodwall will include a walkway bridge at elevation 119.0 feet, NGVD, to allow access to the pumping plant during extreme high water.

INLET AND OUTLET RETAINING WALLS

108. The inlet walls will retain backfill to elevation 95.0 feet, NGVD, as shown on Plate 4-49. The inlet walls will consist of inverted T-type retaining wall monoliths which extend 50 feet parallel to flow before turning 45 degrees and extending approximately 200 feet. The top of the inlet retaining wall will be elevation 95.5 feet, NGVD. The outlet walls are essentially the same except they retain backfill to elevation 104.0 feet, NGVD, and the top of the retaining wall will be elevation 104.5 feet, NGVD. A backfill drainage system consisting of an 8-inch perforated PVC collector pipe surrounded by select sand backfill will be provided for both the inlet and outlet retaining walls. For additional information, see Plate 4-50.

APPROACH APRON

109. An approach slab may be required depending upon the results of hydraulic model testing and seepage analysis.

APPROACH MONOLITH

110. The four approach monoliths will consist of slabs and piers as shown on Plates 4-50 and 4-51. The slab and pier thickness shown are estimated and final thickness will be determined in the final design. The approach monoliths will be approximately 89 feet wide by 80 feet long. In addition to preventing cross currents, the piers will provide support for the trashracks, trash rakes, and service bridge.

111. The service bridge will consist of a concrete deck and concrete girders. Slots will be provided in the upstream portion of the approach monolith piers to accommodate stoplog closure.

PUMP BAY MONOLITH

112. The four pump bay monoliths will consist primarily of a substructure, a superstructure, and a gantry deck as shown on Plates 4-49 through 4-52. The monoliths will be approximately 89 feet wide by 101 feet long. Final monolith lengths are contingent upon the approach monolith pier thickness which have been estimated. Final monoliths lengths will be determined in the final design. The substructure extends from the operating floor at elevation 105.5 feet, NGVD, down to the bottom of the monolith at approximate elevation 52.0 feet, NGVD. The substructure consists of a massive concrete pour with block-outs for the pump intake, pump impeller, discharge elbow, discharge conduit, and pump maintenance area.

113. The substructure also includes the bulkhead gate operator support area at elevation 110.0 feet, NGVD, and the shutter gate operator/gantry deck at elevation 119.0 feet, NGVD. The shutter gate operator/gantry deck will consist of a reinforced concrete slab supported by reinforced concrete beams, columns, and walls. The downstream portion of the pump bay monolith will contain backflow gates and hoists at elevation 119.0 feet, NGVD. The superstructure will extend upward to the roof from elevation 110.0 feet, NGVD, on the landside and elevation 119.0 feet, NGVD, on the river side. It will consist primarily of a framework of columns and girders which will support concrete panels, curtain walls, a bridge crane, and the roof. The roof will be supported by long span bar joists.

DISCHARGE APRON

114. A discharge apron may be required dependent upon hydraulic model testing and seepage analysis.

HIGHWAY NO. 465

115. The roadway for Highway No. 465 will be realigned to accommodate a new bridge with a skew angle of 30 degrees from perpendicular to the proposed channel centerline and raised to elevation 105 feet, NGVD, as shown on Plate 4-46. The new Highway No. 465 bridge will be approximately 570 feet in length over the proposed outlet channel and will be located approximately 900 feet downstream of the pumping plant. This embankment material will be obtained from the excavated material deposited from the pumping plant construction and moved to the road approachment location by the Mississippi Department of Transportation (MDOT).

FUEL TRANSFER DOCK

116. A structural steel fuel transfer dock will be constructed approximately 1,300 feet downstream of the pumping plant, as shown on Plate 4-46, to allow for the offloading of diesel fuel from barges. Dolphins will be provided to protect the dock and secure the barges during offloading of the fuel. Fuel will be transferred from barges via a piping system to storage tanks approximately 400 feet upstream of the pumping plant. Details of the fuel transfer dock are shown on Plate 4-57.

STOPLOGS

117. Two different sets of stoplogs will be required--one for the landside and another for the riverside. The stoplogs will be fabricated from structural steel with rubber J-bulb seals. A lifting beam will be required for each size stoplog. The landside stoplogs will be stored in the maintenance area. The riverside stoplogs will be stored in a raised position in the discharge stoplog slot.

PUMPING PLANT FACILITIES AND APPURTENANCES

SUPERSTRUCTURE

118. Exterior walls will be of precast concrete panels recessed into the framework. The precast concrete will be treated with a light sandblast textured finish. Precast concrete is preferable to pour-in-place concrete in architectural application because it allows for greater control over the finish color and texture of the concrete surfaces. The pumping plant roof will be a sloping batten seam metal roof with a baked-on enamel finish. The roof structure will be a rigid insulating roof deck over steel joists. Penetrations in the roof; i.e., vent stacks, skylights, exhaust fans, etc., will be avoided in order to preserve a clean, uncluttered appearance and enhance the integrity of the roof against potential leaks. Natural lighting will be provided by insulating fixed glass mounted in aluminum frames along the upstream face of the superstructure. The interior of the pumping plant superstructure will be lined with 3.5-inch-thick fiberglass insulation inside polyethylene bags covered with perforated aluminum sheeting for sound attenuation. Aluminum louvers and supply fans also installed in the upstream wall will provide ventilation.

CONTROL ROOM

119. An in-plant, climate-controlled control room will be elevated at elevation 119.0 feet, NGVD, and glassed with acoustical triple-paned glass to provide increased observation of and isolation from the pumping plant operating floor. The control room will house the plant monitoring and remote control equipment and related peripherals. The office, lounge, and kitchen will be incorporated into the control room. The men's and women's restrooms and mechanical room will be located below the control room at elevation 105.5 feet, NGVD. The mechanical room will house the emergency generator set, hydraulic pumps and reservoir for the gate operators, and compressed air storage tank. The air compressor will be located outside the building.

SERVICE BAY

120. The Service Bay area, serviced by the bridge crane and a flatbed truck, having enough room to completely disassemble one pump will be provided inside the pumping plant. A service hatch will be provided at the gantry crane deck for lowering of backflow gates and equipment to the in-plant service area.

MAINTENANCE AREA

121. A fenced outside area will be provided for the mobile equipment storage building; paint, oil, and lubrication storage building; well house; intake stoplog storage; miscellaneous storage; and general maintenance. The outside maintenance area will be paved.

MOBILE EQUIPMENT STORAGE BUILDING

122. A building located in the outside maintenance area will be required for the storage of the mobile crane, front-end loader, forklift, and tractors and to provide a sheltered area for miscellaneous storage and maintenance. The building will be a pre-engineered single span metal building of approximately 3,600 square feet, roofed, enclosed on four sides, and with a concrete floor. Garage doors will be provided on one side for equipment entrance.

PAINT, OIL AND LUBRICATION STORAGE

123. A concrete block building of about 600 square feet will be located in the outside maintenance area for the storage of makeup oil, grease, and paint required for normal maintenance.

WELL HOUSE

124. A concrete block building of approximately 150 square feet will be located in the maintenance area to house the potable water pump, water treatment facilities, and storage tank.

FUEL OIL AND LUBE OIL STORAGE AREA

125. A fenced fuel oil and lube oil storage area will be provided. Two 250,000-gallon fuel storage tanks, clean lube oil storage tanks, and dirty lube oil storage tanks will be located within this area.

PUMPS

General

126. The pumps presented in this appendix reflect previous pump selection presented in DM No. 19 Pump and Prime Mover.

Pump Design Criteria

127. The pumping plant will include identical pumps rated at 1,167 cfs each, for a total plant design capacity of 14,000 cfs. The rated capacity will be discharged against a static (pool-to-pool) head of 3.7 feet. The maximum design static head is 20.0 feet, against which a capacity of 667 cfs per pump is required. Furthermore, each pump will be required to discharge not less than 1,167 cfs against a static head of -1.0 foot (the expected typical condition at start-up). These requirements are tabulated in Table 6-16.

TABLE 6-16
DESIGN CONDITIONS FOR EACH PUMP

Static Head (feet)	Minimum Capacity (cfs)
20.0	667
3.7	1,167 (rated)
-1.0	1,167

128. The average annual operating time of the pumping plant will be approximately 1,200 hours. The target landside elevation is 87.0 feet, NGVD, year-round. The maximum design pumping head of 20 feet (static) is reached with the river rising. Landside stages will be allowed to rise such that the design pump head limit is not exceeded.

Formed Suction Intake

129. The pumps will utilize a formed suction intake (FSI). Model testing has proven that this design minimizes submerged vortexing and pre-rotation at the pump intake, resulting in smoother pump operation. The elbow and conical section of the FSI will be fabricated from steel plate, which will form an embedded liner for pouring the concrete. Removable concrete forms will be used for the portion of the FSI upstream of the elbow.

ENGINES

General

130. The engines selected as the prime movers for the pumping units will be diesel-fueled engines.

Engine Design Criteria

131. The power requirements for the engines are based on the pump horsepower requirements. During normal operation, the greatest power demand will occur at the design maximum head of 20.0 feet or when priming the siphon during pump start-up. Given the constraints of the plant

structure, siphon priming will require about 20.0 feet total dynamic head from the pump. Therefore, normally the greatest power demand will be about 2,500 horsepower (hp). DM No. 19 explained that if the pumps are started when the river is high (above the siphon invert), either a variable speed drive or shutter gates must be used. If the shutter gates are used, as a worst case the pumps will operate against about 22.5 feet total dynamic head until the gates are raised. The maximum power demand will be approximately 2,650 hp. If a variable speed drive is used, the shutter gates will not be required, and the power requirement will not exceed 2,500 hp. The diesel engines will act as a variable speed drive; therefore, the shutter gates may not be required and the power requirement will not exceed 2,500 hp.

Engine Selection

132. The continuous duty horsepower rating of the engine should be 2,500 hp plus an anticipated 3 percent loss through the speed reducer for a rating of 2,575 hp. It is anticipated that a number of engine suppliers will be able to supply engines to meet these requirements.

SPEED REDUCERS

133. The speed reducers will be right-angle single reduction units designed for flood control pump drive service. The rating of the speed reducer should be 2,575 hp with a service factor of 1.5. It is anticipated that a number of gear suppliers will be able to supply gears to meet these requirements.

COOLING SYSTEM

134. The cooling system will provide the cooling requirements for the engines and speed reducers. Each pumping unit will be equipped with marine keel-cooler type heat exchangers located in the approach monolith.

GATES AND GATE OPERATORS

135. The bulkhead gates will be located on the intake to each pump. The bulkhead gates serve the dual purposes of allowing the pump impellers to be dry during nonpumping periods and as the emergency backflow gates. The shutter gates on the riverside provide backflow protection and allow the pumps to come up to speed when a discharge head is present. Both gates will be roller type.

136. The gate operators will be hydraulic cylinders with dogs for open position. A centrally located hydraulic reservoir with dual pumps will supply the cylinders.

CRANES

137. A 60-ton bridge crane will be located inside the superstructure. A 25-ton gantry crane will service the shutter gates and stoplogs.

TRASH RAKES

138. Catenary type, electric motor operated trash raking system will remove trash to the service bridge.

ADDITIONAL EQUIPMENT

139. Additional equipment consists of the following:

a. Fuel oil system.

b. Clean lubrication oil system.

c. Dirty lubrication oil system.

d. Heating, ventilating, and air conditioning.

e. Unwatering system.

f. Portable water system.

g. Waste water system.

h. Washdown water system.

i. Compressed air system.

j. Vacuum breaker system.

k. Standby generator set.

l. Fire extinguishers.

m. Lighting system.

n. Lightning protection.

o. Communications.

ESTIMATED AVERAGE ANNUAL OPERATION AND MAINTENANCE (O&M) COSTS AND MAJOR REPLACEMENT

Estimated Average Annual O&M Costs

140. The O&M costs presented in this paragraph include the cost of having personnel on duty at the pump station, cost of routine maintenance for the diesel engines, and diesel fuel cost. For the 14,000-cfs pump station capacity (12 pumps), the personnel cost is estimated at $752,000, and the estimated cost of routine maintenance on the diesel engines is $60,000. The personnel

cost and routine maintenance cost is expected to be constant, regardless of the ponding area elevation. The average annual diesel fuel costs for the 14,000-cfs pump station will vary depending on the ponding area elevation. Diesel fuel cost is based on a price of $0.86 per gallon of diesel fuel delivered by barge to the site. The O&M costs for the various ponding elevations are presented in Table 6-17.

TABLE 6-17
O&M COSTS FOR VARIOUS PONDING ELEVATIONS

Pump Station Capacity	Ponding Area Elevation (ft, NGVD)	Personnel Cost ($)	Maintenance Cost ($)	Fuel Cost ($)	Total Average Annual O&M Cost ($)
14,000-cfs	80.0	752,000	60,000	379,271	1,191,271
14,000-cfs	85.0	752,000	60,000	253,041	1,065,041
14,000-cfs	87.0	752,000	60,000	182,755	994,755
14,000-cfs	88.5	752,000	60,000	142,171	954,171
14,000-cfs	91.0	752,000	60,000	76,233	888,233

Estimated Major Replacement Cost

141. Major replacement cost is expected to incurred at 35 years into the project life. The major replacement items and their present estimated costs are presented in Table 6-18. The present value of the major replacement items for the 14,000-cfs capacity pump station (12 pumps) is estimated to be $21,083,000.

TABLE 6-18
ESTIMATED MAJOR REPLACEMENT COST

Major Replacement Item Description	Estimated Cost Per Three Pumps (one monolith) ($)
2,700 Horse Power Diesel Engine	1,200,000
Axial Flow Pump	2,941,332
Speed Reducer	990,000
Backstop Device	81,066
High Speed Coupling	29,292
Low Speed Coupling	28,944
Total per Three Pumps	5,270,634

DEVIATIONS FROM PREVIOUS DESIGN MEMORANDUM

142. There are several features of the design presented here which deviate from the design presented in DM No. 19, "Pump and Prime Mover." The most significant deviation is the use of diesel engines to power the pumps rather than electric motors. Other deviations are hydraulic gate hoists, and right angle speed reducers.

ACCESS ROADS

143. Construction and permanent access to the Yazoo Backwater Pumping Plant will be by Highways Nos. 61 and 465 from Vicksburg. From Highway No. 465 approximately 0.5 mile of access road will be constructed providing access to the pumping plant and joining the plant to the service road on the Yazoo Backwater levee. This access road will have a roadway width of 24 feet and an asphalt surface. During flood conditions when Highway No. 465 becomes inundated, levee roads will provide access.

PERIODIC INSPECTION AND CONTINUING EVALUATION

144. The periodic inspection and continuing evaluation portion of the supplement is the same as GDM No. 20.

ENERGY ANALYSIS

GENERAL

145. An energy analysis was performed to determine the pump operating costs so that the most cost-effective pumping plant configuration is selected. Electric motors and diesel engines as pump prime movers were compared. The first six documents listed in Table 6-1 describe the electric-motor drive alternatives. This paragraph focuses on the motors and engines as energy using devices.

ASSUMPTIONS

146. Certain assumptions were made for the energy analysis:

a. Standby Power. The differences in the costs of the standby power systems of all alternatives could be neglected. Diesel-electric generators would provide plant service power during utility power outages. The ratings of these systems, increasing as plant size increases with the alternative, are small when compared to the main pump power required. For alternatives of equal plant size, the differences in engine-generator set size could be neglected.

The size would be similar because of fewer auxiliaries on the pump diesel-engine would require electric power. The diesel engines used to drive the pumps would power many of the auxiliaries on the engines, much like the alternator and water pump are powered on a car or truck.

b. Plant Auxiliary Systems. Differences in plant auxiliary systems, such as lighting and receptacles and other miscellaneous electrical systems, could be neglected. The differences in the number of pumps in a particular type of alternative had little effect because the costs of the auxiliary systems are so small compared to the total electrical construction cost.

c. Engineering Considerations.

(1) Pumping station structure. At the onset of the consideration of diesel engines as prime movers, it was determined that diesel engines would fit into the pumping plant structure that was designed for electric motors. Not having to enlarge the operating floor would provide large savings.

(2) Permanent power. Permanent power would be available for all pumping plant alternatives. For the diesel-engine alternatives, a 15-kilovolt Class distribution feeder of approximately 10 miles in length would be run from Yazoo Valley Electric Power Association's (YVEPA) Redwood Substation. For the electric-motor alternatives, a 115-kilovolt Class subtransmission line would be run from Entergy's North Vicksburg Substation.

(3) Auxiliary power. The power drawn by auxiliary equipment contributes little to the average power-factor because the auxiliary load (mostly lighting and heating) is relatively small and of high power-factor. Therefore, the auxiliary load can be neglected for the purposes of the energy analysis.

d. Pump Operating Costs. The process to forecast the annual cost for operating the various alternative pump drives, namely, electric motors and diesel engines, begins with Hydraulic Engineering Center-Interior Flood Hydrograph (HEC-IFH).

(1) General. HEC-IFH is the source of pumping data needed to compute the pump operating costs. Those pumping data are generated during an IFH continuous simulation analysis (CSA) of pumping plant operation over the period-of-record (POR). IFH pumping data are extracted from the database output file generated by a CSA. Postprocessing of these IFH pumping data using pump and driver models results in month-by-month electrical meter and diesel fuel consumption histories that give the best predictions of pump operation costs available. Applying electric and fuel rates on a monthly basis over the POR result in electrical and diesel billing histories, from which the average annual cost of operating the pumps naturally follows.

(2) Extending IFH.

(a) IFH CSA's of pumping plant operation over the period-of-record compute and summarize monthly, annual, and total pumping plant operation data, such as energy usage and pump operating time. However, IFH does not estimate demand and power factor. Although pump operation data can be utilized to give a rough estimate of maximum demand during the POR, such data cannot be used to account for the effects of the monthly demands on the electric bill over the POR. Such data are also not amenable to evaluating power-factor correction.

(b) Also, IFH computes pump energy usage in megawatts per hour, not gallons of diesel fuel. Given an average value of engine efficiency, fuel quantities can be very roughly estimated by converting the resulting megawatts per hour to British Thermal Units (BTU), then applying the high-heat value to convert BTU to volume of fuel, and finally dividing by the average engine and speed reducer efficiencies.

(c) IFH provides detailed output reports, called calculation period summaries, of pumping plant operation data as a database. The pumping data generated by IFH only while the pumping plant was operating are extracted from the IFH output database and placed into an ASCII-delimited or comma-separated-value (CSV) file. Each extracted record has fields for the date, time, flow, ponding area elevation, and static (differential) head computed during each time step while pumping; a 24-hour time step was used in this study. The CSV file is then processed in an Excel workbook to produce the electrical metering and fuel usage histories. The output data generated using input data from IFH are energy usage; real, reactive, and apparent motor input power (demands); average power factor; and fuel usage. Basically, the energy computations and pump operating times computed by IFH are ignored in favor of the Excel-based method of extending IFH.

(d) If the published pump performance curves are entered into IFH, where only the bowl losses are taken into account, underestimates of pump operating costs will result. Also in IFH, the system head loss is assumed constant, but it is not — it is a quadratic. Then, to properly configure the pump characteristics in IFH, the system loss curve is built into the pump H-Q (head-capacity) and η-Q (efficiency-capacity) curves and the drive efficiency is included in the η-Q curve. These may be called a "static (pool-to-pool) pump performance curves," in which all losses are taken into account, modeling the entire pumping system from intake to discharge. However, the pump operating results in IFH are not all that are needed to forecast pump operating costs for electric motors or internal combustion engines.

(e) Electric power demand charges, power-factor penalties, and minimum monthly charges can add significantly to pumping plant operation costs. Because of the way demand is measured and used to calculate various charges for monthly electric bills, it can cause a dramatic increase in the annual electrical operation cost. Thus, it should be no surprise that concerns are frequently expressed over demand charges. The billing demand charge usually penalizes the

seasonal consumer, like the flood-control pumping plants. Also, energy charges, power-factor penalties, and minimum monthly charges are sometimes linked to the billing demand. An electrical metering and billing history can account for these charges.

(3) Histories. Applying the applicable rate schedule from YVEPA to the electrical metering history results in an electrical billing history, which is a month-by-month cost history of electric bills over the POR. Unit fuel costs are similarly applied to the fuel usage history. Average annual electric bill and fuel usage cost are calculated from all the months in the POR. Computation of the electrical metering and billing histories gives as accurate a prediction of electrical operation costs as one could hope. The process is much simpler than computing electrical energy usage where internal combustion engines are being considered. Only the average annual volume of diesel fuel need be computed before applying unit costs for fuel.

(4) Benefits. The main benefit of this method is that demand and power factor can now be adequately estimated. Another benefit is that power-factor correction, drive efficiency, and different electric utility rate schedules can be readily evaluated. The last benefit is that the electric utility and fuel supplier need to have an understanding of the amount of energy to be supplied and when.

(5) Pump station operation and maintenance costs. These are the costs for operating and maintaining the pumping plant, less the costs for operating the pumping units. These costs are shown in the MCACES attachment (Attachment 1).

RESULTS

147. Diesel fuel cost (excluding engine maintenance) was significantly lower than electrical cost, approximately 8 to 10 times lower. Even when the higher cost of maintaining the diesel engines (over electric motors) is taken into account, the total cost for operation and maintenance

of the engines is still significantly lower than that associated with electric motors. The high electric rates proposed by YVEPA and relatively lower diesel fuel cost priced the electric motor option out of reach. The diesel engine alternative was further supported by the use of the same floor space as was used with electric motor.

148. Table 6-19 is a sample of the calculation period data generated from the 14,000-cfs (400 cubic meters per second), 12-pump alternative for the 51-year POR. Table 6-20 is a partial listing of the electrical metering and fuel usage histories with the billing history for consecutive years and POR statistics for the same alternative. Table 6-21 is given as an example of how much demand charges, power-factor penalties, and the minimum monthly charge can affect the electrical operation costs.

SECTION 5 - RELOCATIONS

149. Construction of the Yazoo Backwater Pumping Station will require MDOT to build a new State Highway 465 bridge across the outlet channel of the pumping station. The bridge deck will be constructed to elevation 105.0 feet, NGVD. It will be built to current State of Mississippi standards of 40 feet wide, including walkways outside the traffic lanes and to a length of 750 feet. It will require approximately 20,000 cubic yards of fill material for the new road approachments. This embankment material will be obtained from the excavated material deposited from the pump station construction and moved to the road approachment location by MDOT.

TABLE 6-19
POWER, ENERGY, AND FUEL USAGE--TOTAL, MIN, AVERAGE, AND MAX PERIOD-OF-RECORD VALUES

Date	Q	h_sump	h_static	h_river	h_total	N	Pump_eff	Bhp	E_Load	M_Load	Motor_eff	Motor_pf	P_Input	S_Input	W_e	Fuel_use
Apr 73	12998	89.57	(7.74)	97.31	10.07	4	78.0%	4755.5	64.4%	64.0%	95.5%	82.9%	15,044.7	18,098.3	360,112	7,870.8
Apr 73	12969	89.73	(7.83)	97.56	10.15	4	78.2%	4773.9	64.7%	64.3%	95.5%	83.0%	15,061.8	18,152.9	361,484	7,896.3
Apr 73	12946	89.86	(7.90)	97.76	10.22	4	78.3%	4787.6	64.8%	64.5%	95.5%	83.0%	15,104.6	18,193.7	362,511	7,915.3
Apr 73	12901	89.95	(8.05)	98.00	10.35	4	78.5%	4820.2	65.3%	64.9%	95.5%	83.1%	15,205.9	18,290.3	364,942	7,960.5
Apr 73	12881	90.02	(8.11)	98.13	10.40	4	78.6%	4831.3	65.4%	65.1%	95.5%	83.2%	15,240.7	18,323.3	365,776	7,976.1
Apr 73	12856	90.06	(8.19)	98.25	10.48	4	78.7%	4847.5	65.7%	65.3%	95.5%	83.2%	15,290.9	18,371.0	366,981	7,998.5
Apr 73	12809	90.08	(8.34)	98.42	10.61	4	79.0%	4877.1	66.1%	65.7%	95.5%	83.3%	15,383.1	18,458.5	369,195	8,039.6
Apr 73	12746	90.09	(8.54)	98.63	10.79	4	79.3%	4915.4	66.6%	66.2%	95.5%	83.5%	15,502.2	18,571.0	372,053	8,092.8
Apr 73	12693	90.10	(8.71)	98.81	10.94	4	79.5%	4947.5	67.0%	66.6%	95.5%	83.6%	15,602.1	18,665.2	374,451	8,137.4
Apr 73	12710	90.12	(8.65)	98.77	10.89	4	79.5%	4934.8	66.8%	66.5%	95.5%	83.5%	15,562.6	18,628.0	373,503	8,119.8
Apr 73	12718	90.13	(8.62)	98.75	10.86	4	79.4%	4928.0	66.7%	66.4%	95.5%	83.5%	15,541.5	18,608.0	372,995	8,110.3
Apr 73	12719	90.13	(8.62)	98.75	10.86	4	79.4%	4928.9	66.8%	66.4%	95.5%	83.5%	15,544.1	18,610.5	373,058	8,111.5
Apr 73	12708	90.11	(8.66)	98.77	10.90	4	79.5%	4937.7	66.9%	66.5%	95.5%	83.6%	15,571.4	18,636.3	373,715	8,123.7
Apr 73	12684	90.08	(8.74)	98.82	10.97	4	79.6%	4953.4	67.1%	66.7%	95.5%	83.6%	15,620.4	18,682.4	374,891	8,145.6
Apr 73	12640	90.04	(8.87)	98.91	11.08	4	79.8%	4974.4	67.4%	67.0%	95.5%	83.7%	15,685.7	18,743.7	376,456	8,174.7
Apr 73	12598	89.98	(9.01)	98.99	11.21	4	80.0%	5001.3	67.7%	67.4%	95.5%	83.8%	15,769.2	18,822.1	378,461	8,212.0
Apr 73	12576	89.94	(9.07)	99.01	11.26	4	80.1%	5011.4	67.9%	67.5%	95.5%	83.8%	15,800.7	18,851.5	379,217	8,226.1
Apr 73	12559	89.91	(9.13)	99.04	11.32	4	80.1%	5025.2	68.1%	67.7%	95.6%	83.9%	15,843.7	18,891.7	380,248	8,245.3
Apr 73	12590	89.92	(9.03)	98.95	11.23	4	80.0%	5004.2	67.8%	67.4%	95.5%	83.8%	15,778.2	18,830.4	378,677	8,216.0
Apr 73	12623	89.95	(8.93)	98.88	11.14	4	79.9%	4986.8	67.5%	67.2%	95.5%	83.7%	15,724.1	18,779.7	377,377	8,191.9
Apr 73	12663	90.01	(8.80)	98.81	11.02	4	79.7%	4962.6	67.2%	66.8%	95.5%	83.6%	15,648.9	18,709.1	375,573	8,158.3
Apr 73	12783	90.07	(8.42)	98.49	10.68	4	79.1%	4891.9	66.3%	65.9%	95.5%	83.4%	15,429.1	18,501.9	370,298	8,060.1
Apr 73	12867	90.13	(8.16)	98.29	10.45	4	78.7%	4842.8	65.6%	65.2%	95.5%	83.2%	15,276.4	18,357.2	366,632	7,992.0
Apr 73	12831	90.22	(8.27)	98.49	10.55	4	78.8%	4863.4	65.9%	65.5%	95.5%	83.3%	15,340.5	18,418.1	368,172	8,020.6
Apr 73	12735	90.37	(8.57)	98.94	10.82	4	79.3%	4919.7	66.6%	66.3%	95.5%	83.5%	15,515.7	18,583.7	372,376	8,098.8
Apr 73	12728	90.60	(8.59)	99.19	10.83	4	79.4%	4922.9	66.7%	66.3%	95.5%	83.5%	15,525.5	18,593.0	372,611	8,103.2
Apr 73	12767	90.89	(8.47)	99.36	10.73	4	79.2%	4901.2	66.4%	66.0%	95.5%	83.4%	15,458.2	18,529.4	370,996	8,073.1
Apr 73	12819	91.21	(8.31)	99.52	10.58	4	78.9%	4871.8	66.0%	65.6%	95.5%	83.3%	15,366.4	18,442.6	368,794	8,032.2
Apr 73	12899	91.54	(8.05)	99.59	10.35	4	78.5%	4818.5	65.3%	64.9%	95.5%	83.1%	15,200.7	18,285.3	364,817	7,958.2
Apr 73	12964	91.84	(7.85)	99.69	10.17	4	78.2%	4779.1	64.7%	64.4%	95.5%	83.0%	15,078.2	18,168.5	361,876	7,903.5
May 73	12987	92.13	(7.77)	99.90	10.10	4	78.1%	4760.6	64.5%	64.1%	95.5%	82.9%	15,020,4	18,113.3	360,489	7,877.8
May 73	12997	92.40	(7.74)	100.14	10.07	4	78.0%	4754.7	64.4%	64.0%	95.5%	82.9%	15,002.1	18,095.8	360,051	7,869.6
May 73	13063	92.66	(7.53)	100.19	9.88	4	77.7%	4709.6	63.8%	63.4%	95.5%	82.7%	14,861.6	17,961.1	356,678	7,806.9
May 73	13120	92.91	(7.35)	100.26	9.72	4	77.4%	4670.2	63.3%	62.9%	95.5%	82.6%	14,739.0	17,843.1	353,737	7,752.3
May 73	13170	93.14	(7.20)	100.34	9.59	4	77.2%	4638.7	62.8%	62.5%	95.4%	82.5%	14,640.9	17,748.4	351,382	7,708.5
May 73	13237	93.37	(6.94)	100.31	9.35	4	76.6%	4577.6	62.0%	61.6%	95.4%	82.3%	14,450.6	17,563.9	346,814	7,623.7
May 73	13291	93.57	(6.72)	100.29	9.15	4	76.1%	4528.9	61.3%	61.0%	95.4%	82.1%	14,298.8	17,416,1	343,172	7,556.1
May 73	13314	93.77	(6.62)	100.39	9.06	4	75.9%	4504.6	61.0%	60.7%	95.4%	82.0%	14,223.0	17,342.0	341,352	7,522.3
May 73	13321	93.95	(6.60)	100.55	9.04	4	75.8%	4502.3	61.0%	60.6%	95.4%	82.0%	14,215.9	17,335.1	341,183	7,519.2
May 73	13333	94.13	(6.55)	100.68	8.99	4	75.7%	4490.6	60.8%	60.5%	95.4%	82.0%	14,179.3	17,299.2	340,303	7,502.8
May 73	13336	94.30	(6.53)	100.83	8.98	4	75.6%	4483.9	60.7%	60.4%	95.4%	81.9%	14,158.4	17,278.8	339,801	7,493.5
May 73	13341	94.45	(6.51)	100.96	8.96	4	75.6%	4479.3	60.7%	60.3%	95.4%	81.9%	14,144.3	17,264.9	339,463	7,487.2
May 73	13440	94.58	(6.10)	100.68	8.58	4	74.6%	4380.0	59.3%	59.0%	95.4%	81.6%	13,834.5	16,959.9	332,028	7,349.3
May 73	13506	94.69	(5.83)	100.52	8.33	4	73.9%	4312.4	58.4%	58.1%	95.4%	81.3%	13,623.7	16,750.8	326,969	7,255.5
May 73	13522	94.79	(5.76)	100.55	8.27	4	73.8%	4293.3	58.1%	57.8%	95.4%	81.3%	13,564.1	16,691.4	325,538	7,229.0
May 73	13528	94.87	(5.73)	100.60	8.24	4	73.7%	4284.2	58.0%	57.7%	95.4%	81.2%	13,535.5	16,663.0	324,852	7,216.2
May 73	13550	94.93	(5.64)	100.57	8.16	4	73.5%	4260.8	57.7%	57.4%	95.3%	81.1%	13,462.5	16,590.1	323,101	7,183.8
May 73	13611	94.97	(5.39)	100.36	7.93	4	72.9%	4194.3	56.8%	56.5%	95.3%	80.9%	13,254.9	16,381.9	318,117	7,091.4
May 73	13652	95.00	(5.22)	100.22	7.77	4	72.5%	4147.3	56.2%	55.9%	95.3%	80.7%	13,108.1	16,234.0	314,593	7,026.2
May 73	13716	95.02	(4.95)	99.97	7.52	4	71.8%	4069.3	55.1%	54.8%	95.3%	80.5%	12,864.5	15,987.2	308,747	6,917.9
May 73	13799	95.03	(4.60)	99.63	7.20	4	71.0%	3964.3	53.7%	53.4%	95.3%	80.1%	12,536.2	15,651.9	300,870	6,772.2
May 73	13797	95.03	(4.61)	99.64	7.21	4	71.0%	3967.8	53.7%	53.4%	95.3%	80.1%	12,547.0	15,663.0	301,128	6,776.9
May 73	13773	95.02	(4.71)	99.73	7.30	4	71.3%	3997.9	54.1%	53.8%	95.3%	80.2%	12,641.2	15,759.5	303,390	6,818.7
May 73	13858	95.00	(4.33)	99.33	6.95	4	70.1%	3893.8	52.7%	52.4%	95.2%	79.8%	12,315.6	15,424.7	295,574	6,674.1
May 73	13959	94.97	(3.87)	98.84	6.54	4	68.6%	3767.8	51.0%	50.7%	95.2%	79.4%	11,921.5	15,015.4	286,116	6,499.2
May 73	14053	94.94	(3.44)	98.38	6.15	4	67.2%	3641.2	49.3%	49.0%	95.1%	78.4%	11,535.8	14,710.2	276,859	6,323.4
May 73	14233	94.91	(2.61)	97.52	5.39	4	64.5%	3370.2	45.6%	45.4%	94.7%	75.5%	10,723.2	14,208.4	257,357	5,947.1
May 73	14383	94.88	(1.93)	96.81	4.77	4	62.3%	3124.5	42.3%	42.1%	94.3%	72.8%	9,980.7	13,710.1	239,537	5,606.0
May 73	14452	94.87	(1.53)	96.40	4.40	4	61.0%	2949.7	40.0%	39.7%	94.0%	70.9%	9,448.7	13,327.6	226,770	5,363.2
May 73	14527	94.86	(1.08)	95.64	3.97	4	59.7%	2740.2	37.1%	36.9%	93.7%	68.6%	8,807.1	12,835.3	211,371	5,072.3
May 73	14660	94.86	(0.27)	95.13	3.21	4	57.2%	2327.4	31.5%	31.3%	93.1%	64.1%	7,530.3	11,743.3	180,728	4,499.0

Yazoo River Basin, Yazoo Backwater Area, Mississippi, Yazoo Backwater Pumping Plant, Reformulation Study.

TABLE 6-20
DEMAND, ENERGY, AND FUEL USAGES AND COSTS FOR THE 12-PUMP, 14,000-CFS ALTERNATIVE

MONTH	YEAR	Motor_pf	P_Input	S_Input	W_e	Fuel_use	Billing kW	Demand	Energy	FCA	Total Bill	Diesel
1	1972	100.0%	0	0	0	0	0	$0	$0	$0	$45,000	$0
2	1972	100.0%	0	0	0	0	0	$0	$0	$0	$45,000	$0
3	1972	65.0%	8,287	12,409	1,119,131	27,645	8,287	$45,991	$75,206	$8,393	$129,691	$19,351
4	1972	71.7%	10,671	14,175	1,158,761	27,303	10,671	$59,226	$77,869	$8,691	$145,885	$19,112
5	1972	76.2%	12,292	15,401	5,816,552	133,846	12,292	$68,223	$390,872	$43,624	$502,820	$93,692
6	1972	100.0%	0	0	0	0	0	$0	$0	$0	$45,000	$0
7	1972	100.0%	0	0	0	0	0	$0	$0	$0	$45,000	$0
8	1972	100.0%	0	0	0	0	0	$0	$0	$0	$45,000	$0
9	1972	100.0%	0	0	0	0	0	$0	$0	$0	$45,000	$0
10	1972	100.0%	0	0	0	0	0	$0	$0	$0	$45,000	$0
11	1972	75.1%	12,067	15,167	2,143,851	49,485	12,067	$66,969	$144,067	$16,079	$227,215	$34,639
12	1972	66.9%	8,908	12,915	2,797,302	67,975	8,908	$49,442	$187,979	$20,980	$258,500	$47,583
1	1973	66.4%	9,069	13,040	3,338,711	81,464	9,069	$50,332	$224,361	$25,040	$299,834	$57,025
2	1973	69.1%	9,977	13,707	4,876,248	116,691	9,977	$55,372	$327,684	$36,572	$419,728	$81,684
3	1973	79.6%	14,963	18,058	5,390,591	121,387	14,963	$83,043	$362,248	$40,429	$485,820	$84,971
4	1973	83.4%	15,844	18,892	11,128,246	242,164	15,844	$87,932	$747,818	$83,462	$919,312	$169,515
5	1973	79.6%	15,020	18,113	9,628,068	215,341	15,020	$83,363	$647,006	$72,211	$802,680	$150,739
6	1973	100.0%	0	0	0	0	0	$0	$0	$0	$45,000	$0
7	1973	100.0%	0	0	0	0	0	$0	$0	$0	$45,000	$0
8	1973	100.0%	0	0	0	0	0	$0	$0	$0	$45,000	$0
9	1973	100.0%	0	0	0	0	0	$0	$0	$0	$45,000	$0
10	1973	100.0%	0	0	0	0	0	$0	$0	$0	$45,000	$0
11	1973	100.0%	0	0	0	0	0	$0	$0	$0	$45,000	$0
12	1973	78.5%	12,920	16,044	2,122,930	47,996	12,920	$71,706	$142,661	$15,922	$230,389	$33,597
1	1974	66.6%	8,652	12,711	5,040,746	122,789	8,652	$48,020	$338,738	$37,806	$424,664	$85,952
2	1974	69.8%	10,200	13,862	3,947,198	94,014	10,200	$56,611	$265,252	$29,604	$351,566	$65,810
3	1974	79.4%	15,439	18,511	3,783,690	84,386	15,439	$85,687	$254,264	$28,378	$368,429	$59,070
4	1974	78.0%	14,979	18,074	7,081,199	160,969	14,979	$83,135	$475,857	$53,109	$612,201	$112,678
5	1974	100.0%	0	0	0	0	0	$0	$0	$0	$45,000	$0
6	1974	100.0%	0	0	0	0	0	$0	$0	$0	$45,000	$0
7	1974	100.0%	0	0	0	0	0	$0	$0	$0	$45,000	$0
8	1974	100.0%	0	0	0	0	0	$0	$0	$0	$45,000	$0
9	1974	100.0%	0	0	0	0	0	$0	$0	$0	$45,000	$0
10	1974	100.0%	0	0	0	0	0	$0	$0	$0	$45,000	$0
11	1974	100.0%	0	0	0	0	0	$0	$0	$0	$45,000	$0
12	1974	100.0%	0	0	0	0	0	$0	$0	$0	$45,000	$0

TABLE 6-21

SUMMARY OF DEMAND, ENERGY, AND FUEL USAGES AND COSTS FOR THE 12-PUMP, 14,000-CFS ALTERNATIVE

MONTH	YEAR	Motor_pf	P_Input	S_Input	W_e	Fuel_use	Billing kW	Demand	Energy	FCA	Total Bill	Diesel
400-cms	MO	Motor_pf	P_Input	S_Input	W_e	Fuel_use	Billing kW	Demand	Energy	FCA	Total Bill	Diesel
SUM	612	#N/A	#N/A	#N/A	595,622,700	13,458,747	#N/A	$10,518,640	$40,025,845	$4,467,170	$75,762,528	$9,421,123
MIN	#N/A	62.6%	0	0	0	0	0	$0	$0	$0	$45,000	$0
AVG	51	79.2%	3,097	3,911	973,240	21,991	3,097	$17,187	$65,402	$7,299	$123,795	$15,394
MAX	#N/A	100.0%	20,343	23,395	11,758,000	255,061	20,343	$112,901	$790,138	$88,185	$973,387	$178,543

Yazoo River Basin, Yazoo Backwater Area, Mississippi, Yazoo Backwater Pumping Plant, Reformulation Study

150. The relocation of one 2-wire, 7.6 kilovolt power line, one 3-inch waterline, and a buried fiber optic telephone cable will be necessary to build the pumping station.

151. The cost to build the new bridge, new approachments, and relocate the three utilities is estimated to be $1.5 million.

152. Any clearing of right-of-way for the construction of the bridge and embankment has been included in the analysis for the recommended plan.

SECTION 6 - HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE (HTRW) ASSESSMENT

153. The HTRW assessment was conducted following guidelines and procedures outlined in the regulation, "Hazardous, Toxic, and Radioactive Waste Guidance for Civil Works Projects," Engineer Regulation 1165-2-132 (U.S. Army Corps of Engineers, 1992), Lower Mississippi Valley Regulation 1165-2-132, "Water Resources and Authorities for Hazardous, Toxic and Radioactive Waste for Civil Works Projects" (14 June 1996), and the American Society for Testing and Materials, E1527-97, "Standard Practice for Environmental Site Assessments: Phase 1 Environmental Site Assessment Process" (ASTM, 1997). Engineer Regulation 1165-2-132 states that Civil Works project funds are not to be employed for HTRW-related activities except when specifically provided by law or where HTRW-contaminated areas or impacts cannot be avoided. The objective for conducting HTRW assessments is to identify HTRW problems early in a project design to ensure appropriate consideration of HTRW problems that can be addressed in the reconnaissance, feasibility, preconstruction engineering and design, land acquisition, construction, operations, maintenance, repair, replacement, and rehabilitation phases of Civil Works projects.

154. The Vicksburg District conducted an HTRW assessment of the proposed pumping station construction area, located near the Steele Bayou control structure in Warren County, Mississippi. Vicksburg District personnel conducted an onsite assessment of the site on the 31 July 1998. HTRW assessments on proposed mitigation and easements properties within the project area/ Mississippi alluvial valley will be conducted after they have been identified and prior to any real estate transactions.

155. The land use of this area is primarily rural and forested. Illegal dumping of household garbage and appliances was scattered along the service road to the Steele Bayou control structure. An abandoned refrigerator, television, and stove were observed scattered along the edge of the service road. No indicators of hazardous wastes were observed during the onsite assessment.

156. In addition to an onsite assessment, a record search of the Mississippi Office of Pollution Control environmental records for known hazardous or potential hazardous waste sites, landfills, leaking underground storage tanks, and national priorities list sites was conducted for this site. No known or potential sites were identified within a 1-mile radius of the proposed pumping station construction area.

157. Based on this assessment, the risk of encountering HTRW on the construction of the pumping station is determined to be low. All construction contracts will require the proper removal and disposal of abandoned appliances, household garbage, and nonhazardous debris encountered during construction on this project.

SECTION 7 - COST ESTIMATE

158. The baseline estimate for the recommended plan was developed with a price level date of 10 January 2000. This estimate has been prepared in accordance with Engineer Circular 1110-2-263. A detailed MCACES cost estimate can be found in Attachment 1. As shown in the estimate, the total project cost for the Yazoo Backwater Pumping Plant is $181,594,962.

SECTION 8 - OPERATION AND MAINTENANCE

GENERAL

159. The operation, maintenance, repair, replacement, and rehabilitation of all completed works after construction is the responsibility of the Corps, except for the inlet and outlet structures. They will be maintained by the local sponsor.

PROPOSED FACILITY

160. The operation and maintenance requirement for the Yazoo Backwater Pumping Plant should be accomplished in accordance with the water control manual and the operation and maintenance manual.

REFERENCES

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ATTACHMENT 1
MCACES

MCACES
INITIAL ARRAY

YBR-ALT2, PUMPS @ 10,500 CFS
YAZOO BACKWATER REFORM. STUDY
Yazoo Backwater Pumping Plant
Alternate No. 1 (10,500 CFS)

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: THOMAS L. HENGST, P.E.

Preparation Date: 05/01/95
Effective Date of Pricing: 05/01/95

Sales Tax: 0.00%

BASIS OF THE GOVERNMENT ESTIMATE

General:

Work performed on this project will accomplished as one item. Work involved will consist of furnishing all plant, labor, materials and equipment to construct the principal features to include: mobilization and demobilization, clearing and grubbing, channel excavation, degrading cofferdam, construction of pumping station, turfing, etc.

Operating Shifts:

Construction operations will be prosecuted in one 10-hour shift per day, six days per week.

Labor:

No difficulty is anticipated in obtaining the required crafts and laborers. It is assumed that the contractor will employ skilled personnel to operate the equipment.

The wage rates used in the estimate are the National Labor Rate Base for 1994. Overtime is computed at the rate of 16.67% of straight time based on the time worked in excess of 40 hours per week.

Employer's liability, general liability, public liability, automotive liability, property damage, and workmen's compensation insurance and social security taxes are added to labor costs for all operations.

Equipment:

Equipment rates aree based on the U. S. Army Corps of Engineers' pamphlet "Construction Equipment Ownership and Operating Expense Schedule" (EP 1110-1-8) for Region III, August 1993.

Materials:

The costs of materials and supplies are based on recent jobs using the same materials which were obtained from various distributors and current catalogs on file in Cost Engineering Branch, or from the Unit Price Book.

REASONS FOR CONTINGENCIES

Feature 09 - Channels and Canals
Feature 11 - Levees and Floodwalls
Feature 13 - Pumping Plant
Feature 19 - Buildings, Grounds and Utilities
Feature 20 - Permanent Operating Equipment

Contingencies for all items will be 15% primarily for probable variation with respect to quantities. Unit costs and the method of construction are not expected to vary greatly.

Feature 30 - Planning, Engineering and Design

The cost of this item is projected to be 15% of construction costs including contingencies by Project Management.

Feature 31 - Construction Management

Contingencies for this item will be 15%. The cost of the item is projected to be 10% of construction costs by Construction Division.

	QUANTY UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COST
01 YBR-ALT2, PUMPS @ 10,500 CFS					
01.09 Channels and Canals					
01.09.01 Channels		2,344,949	351,742	0	2,696,691
TOTAL Channels and Canals	1.00	2,344,949	351,742	0	2,696,691
01.11 Levees and Floodwalls					
01.11.01 Levees	1.00 JOB	456,364	68,455	0	524,818
01.11.02 Floodwalls	1.00 JOB	187,669	28,150	0	215,819
TOTAL Levees and Floodwalls		644,032	96,605	0	740,637
01.13 Pumping Plant					
01.13.00 Pumping Plant		59,451,347	8,917,702	0	68,369,049
TOTAL Pumping Plant	1.00	59,451,347	8,917,702	0	68,369,0
01.19 Buildings, Grounds, & Utilities					
01.19.00 Buildings, Grounds, & Utilities		570,316	85,547	0	655,864
TOTAL Buildings, Grounds, & Utilities		570,316	85,547	0	655,864
01.20 Permanent Operating Equipment					
01.20.00 Permanent Operating Equipment		435,000	65,250	0	500,250
TOTAL Permanent Operating Equipment		435,000	65,250	0	500,250
01.30 Planning, Engineering and Design		9,540,000	0	0	9,540,000
01.31 Construction Management		6,360,000	954,000	0	7,314,000
TOTAL YBR-ALT2, PUMPS @ 10,500 CFS	1.00 EA	79,345,644	10470847	0	89,816,491
TOTAL YBR-ALT2, PUMPS @ 10,500 CFS	1.00 EA	79,345,644	10470847	0	89,816,491

No errors detected...

* * * END OF ERROR REPORT * * *

SUMMARY REPORTS SUMMARY PAGE

No Detailed Estimate...

No Backup Reports...

* * * END TABLE OF CONTENTS * * *

YBR-ALT3, PUMPS @ 14,000 CFS
YAZOO BACKWATER REFORM. STUDY
Yazoo Backwater Pumping Plant
Alternate No. 2 (14,000 CFS)

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: THOMAS L. HENGST, P.E.

Preparation Date: 05/01/95
Effective Date of Pricing: 05/01/95

Sales Tax: 0.00%

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BASIS OF THE GOVERNMENT ESTIMATE

General:

Work performed on this project will accomplished as one item. Work involved will consist of furnishing all plant, labor, materials and equipment to construct the principal features to include: mobilization and demobilization, clearing and grubbing, channel excavation, degrading cofferdam, construction of pumping station, turfing, etc.

Operating Shifts:

Construction operations will be prosecuted in one 10-hour shift per day, six days per week.

Labor:

No difficulty is anticipated in obtaining the required crafts and laborers. It is assumed that the contractor will employ skilled personnel to operate the equipment.

The wage rates used in the estimate are the National Labor Rate Base for 1994. Overtime is computed at the rate of 16.67% of straight time based on the time worked in excess of 40 hours per week.

Employer's liability, general liability, public liability, automotive liability, property damage, and workmen's compensation insurance and social security taxes are added to labor costs for all operations.

Equipment:

sstruction Equipment Ownership and Operating Expense Schedule"
(EP 1110-1-8) for Region III, August 1993.

Materials:

The costs of materials and supplies are based on recent jobs using the same materials which were obtained from various distributors and current catalogs on file in Cost Engineering Branch, or from the Unit Price Book.

REASONS FOR CONTINGENCIES

Feature 09 - Channels and Canals
Feature 11 - Levees and Floodwalls
Feature 13 - Pumping Plant
Feature 19 - Buildings, Grounds and Utilities
Feature 20 - Permanent Operating Equipment

Contingencies for all items will be 15% for probable variation with respect to quantities. Unit costs and the method of construction are not expected to vary greatly.

Feature 30 - Planning, Engineering and Design

The cost of this item is projected to be 15% of construction costs including contingencies by Project Management.

Feature 31 - Construction Management

Contingencies are calculated for this item at 15%. The cost of the item is projected to be 10% of construction costs by Construction Division.

	QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COST
01 YBR-ALT3, PUMPS @ 14,000 CFS						
01.09 Channels and Canals						
01.09.01 Channels			2,593,720	389,058	0	2,982,777
TOTAL Channels and Canals			2,593,720	389,058	0	2,982,777
01.11 Levees and Floodwalls						
01.11.01 Levees	1.00	JOB	456,364	68,455	0	524,818
01.11.02 Floodwalls	1.00	JOB	187,669	28,150	0	215,819
TOTAL Levees and Floodwalls			644,032	96,605	0	740,637
01.13 Pumping Plant						
01.13.00 Pumping Plant			73,444,889	11016733	0	84,461,622
TOTAL Pumping Plant			73,444,889	11016733	0	84,461,6
01.19 Buildings, Grounds, & Utilities						
01.19.00 Buildings, Grounds, & Utilities			570,316	85,547	0	655,864
TOTAL Buildings, Grounds, & Utilities			570,316	85,547	0	655,864
01.20 Permanent Operating Equipment						
01.20.00 Permanent Operating Equipment			435,000	65,250	0	500,250
TOTAL Permanent Operating Equipment			435,000	65,250	0	500,250
01.30 Planning, Engineering and Design			10,100,000	0	0	10,100,000
01.31 Construction Management			7,780,000	1,167,000	0	8,947,000
TOTAL YBR-ALT3, PUMPS @ 14,000 CFS	1.00	EA	95,567,957	12820194	0	108,388,151
TOTAL YBR-ALT3, PUMPS @ 14,000 CFS	1.00	EA	95,567,957	12820194	0	108,388,151

No errors detected...

* * * END OF ERROR REPORT * * *

SUMMARY REPORTS SUMMARY PAGE

No Detailed Estimate...

No Backup Reports...

* * * END TABLE OF CONTENTS * * *

YBR-ALT4, PUMPS @ 17,500 CFS
YAZOO BACKWATER REFORM. STUDY
Yazoo Backwater Pumping Plant
Alternate No. 3 (17,500 CFS)

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: THOMAS L. HENGST, P.E.

Preparation Date: 05/01/95
Effective Date of Pricing: 05/01/95

Sales Tax: 0.00%

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YBR-ALT4, PUMPS @ 17,500 CFS
YAZOO BACKWATER REFORM. STUDY
Yazoo Backwater Pumping Plant
Alternate No. 3 (17,500 CFS)

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: THOMAS L. HENGST, P.E.

Preparation Date: 05/01/95
Effective Date of Pricing: 05/01/95

Sales Tax: 0.00%

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BASIS OF THE GOVERNMENT ESTIMATE

General:

Work performed on this project will accomplished as one item. Work involved will consist of furnishing all plant, labor, materials and equipment to construct the principal features to include: mobilization and demobilization, clearing and grubbing, channel excavation, degrading cofferdam, construction of pumping station, turfing, etc.

Operating Shifts:

Construction operations will be prosecuted in one 10-hour shift per day, six days per week.

Labor:

No difficulty is anticipated in obtaining the required crafts and laborers. It is assumed that the contractor will employ skilled personnel to operate the equipment.

The wage rates used in the estimate are the National Labor Rate Base for 1994. Overtime is computed at the rate of 16.67% of straight time based on the time worked in excess of 40 hours per week.

Employer's liability, general liability, public liability, automotive liability, property damage, and workmen's compensation insurance and social security taxes are added to labor costs for all operations.

Equipment:

Equipment rates aree based on the U. S. Army Corps of Engineers' pamphlet "Construction Equipment Ownership and Operating Expense Schedule" (EP 1110-1-8) for Region III, August 1993.

Materials:

The costs of materials and supplies are based on recent jobs using the same materials which were obtained from various distributors and current catalogs on file in Cost Engineering Branch, or from the Unit Price Book.

REASONS FOR CONTINGENCIES

Feature 09 - Channels and Canals
Feature 11 - Levees and Floodwalls
Feature 13 - Pumping Plant
Feature 19 - Buildings, Grounds and Utilities
Feature 20 - Permanent Operating Equipment

Contingencies for all items will be 15% primarily for probable variation with respect to quantities. Unit costs and the method of construction are not expected to vary greatly.

Feature 30 - Planning, Engineering and Design

The cost of this item is projected to be 12.3% of construction costs including contingencies by Project Management.

Feature 31 - Construction Management

Contingencies for this item will be15%. The cost of the item is projected to be 10% of construction costs by Construction Division.

	QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL CO
01 YBR-ALT4, PUMPS @ 17,500 CFS						
01.09 Channels and Canals						
01.09.01 Channels			2,842,122	426,318	0	3,268,44
TOTAL Channels and Canals			2,842,122	426,318	0	3,268,44
01.11 Levees and Floodwalls						
01.11.01 Levees	1.00	JOB	456,364	68,455	0	524,81
01.11.02 Floodwalls	1.00	JOB	187,669	28,150	0	215,81
TOTAL Levees and Floodwalls			644,032	96,605	0	740,63
01.13 Pumping Plant						
01.13.00 Pumping Plant			91,215,627	13682344	0	104,897,97
TOTAL Pumping Plant			91,215,627	13682344	0	104,897,9
01.19 Buildings, Grounds, & Utilities						
01.19.00 Buildings, Grounds, & Utilities			570,316	85,547	0	655,86
TOTAL Buildings, Grounds, & Utilities			570,316	85,547	0	655,86
01.20 Permanent Operating Equipment						
01.20.00 Permanent Operating Equipment			435,000	65,250	0	500,25
TOTAL Permanent Operating Equipment	1.00		435,000	65,250	0	500,25
01.30 Planning, Engineering and Design	1.00	EA	11,800,000	0	0	11,800,00
01.31 Construction Management	1.00	EA	9,590,000	1,438,500	0	11,028,50
TOTAL YBR-ALT4, PUMPS @ 17,500 CFS	1.00	EA	117,097,097	15794565	0	132,891,66
TOTAL YBR-ALT4, PUMPS @ 17,500 CFS	1.00	EA	117,097,097	15794565	0	132,891,66

No errors detected...

* * * END OF ERROR REPORT * * *

SUMMARY REPORTS SUMMARY PAGE

No Detailed Estimate...

No Backup Reports...

* * * END TABLE OF CONTENTS * * *

YBR-ALT5, PUMPS @ 21,000 CFS
YAZOO BACKWATER REFORM. STUDY
Yazoo Backwater Pumping Plant
Alternate No. 4 (21,000 CFS)

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: THOMAS L. HENGST, P.E.

Preparation Date: 05/01/95
Effective Date of Pricing: 05/01/95

Sales Tax: 0.00%

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BASIS OF THE GOVERNMENT ESTIMATE

General:

Work performed on this project will accomplished as one item. Work involved will consist of furnishing all plant, labor, materials and equipment to construct the principal features to include: mobilization and demobilization, clearing and grubbing, channel excavation, degrading cofferdam, construction of pumping station, turfing, etc.

Operating Shifts:

Construction operations will be prosecuted in one 10-hour shift per day, six days per week.

Labor:

No difficulty is anticipated in obtaining the required crafts and laborers. It is assumed that the contractor will employ skilled personnel to operate the equipment.

The wage rates used in the estimate are the National Labor Rate Base for 1994. Overtime is computed at the rate of 16.67% of straight time based on the time worked in excess of 40 hours per week.

Employer's liability, general liability, public liability, automotive liability, property damage, and workmen's compensation insurance and social security taxes are added to labor costs for all operations.

Equipment:

Equipment rates aree based on the U. S. Army Corps of Engineers' pamphlet "Construction Equipment Ownership and Operating Expense Schedule" (EP 1110-1-8) for Region III, August 1993.

Materials:

The costs of materials and supplies are based on recent jobs using the same materials which were obtained from various distributors and current catalogs on file in Cost Engineering Branch, or from the Unit Price Book.

REASONS FOR CONTINGENCIES

Feature 09 - Channels and Canals
Feature 11 - Levees and Floodwalls
Feature 13 - Pumping Plant
Feature 19 - Buildings, Grounds and Utilities
Feature 20 - Permanent Operating Equipment

Contingencies for these items will be 15% primarily for probable variation with respect to quantities. Unit costs and the method of construction are not expected to vary greatly.

Feature 30 - Planning, Engineering and Design

The cost of this item is projected to be 12% of construction costs including contingencies by Project Management.

Feature 31 - Construction Management

Contingencies for this item will be 15%. The cost of the item is projected to be 10% of construction costs by Construction Division.

	QUANTY UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL CO...
01 YBR-ALT5, PUMPS @ 21,000 CFS					
01.09 Channels and Canals					
01.09.01 Channels		3,070,633	460,595	0	3,531,228
TOTAL Channels and Canals		3,070,633	460,595	0	3,531,228
01.11 Levees and Floodwalls					
01.11.01 Levees	1.00 JOB	456,364	68,455	0	524,818
01.11.02 Floodwalls	1.00 JOB	187,669	28,150	0	215,819
TOTAL Levees and Floodwalls		644,032	96,605	0	740,637
01.13 Pumping Plant					
01.13.00 Pumping Plant		105,457,467	15818620	0	121,276,087
TOTAL Pumping Plant		105,457,467	15818620	0	121,276,0
01.19 Buildings, Grounds, & Utilities					
01.19.00 Buildings, Grounds, & Utilities		570,316	85,547	0	655,864
TOTAL Buildings, Grounds, & Utilities		570,316	85,547	0	655,864
01.20 Permanent Operating Equipment					
01.20.00 Permanent Operating Equipment		435,000	65,250	0	500,250
TOTAL Permanent Operating Equipment	1.00	435,000	65,250	0	500,250
01.30 Planning, Engineering and Design		12,200,000	0	0	12,200,000
01.31 Construction Management	1.00 EA	11,000,000	1,650,000	0	12,650,000
TOTAL YBR-ALT5, PUMPS @ 21,000 CFS	1.00 EA	133,377,448	18176617	0	151,554,066
TOTAL YBR-ALT5, PUMPS @ 21,000 CFS	1.00 EA	133,377,448	18176617	0	151,554,066

No errors detected...

* * * END OF ERROR REPORT * * *

SUMMARY REPORTS SUMMARY PAGE

No Detailed Estimate...

No Backup Reports...

* * * END TABLE OF CONTENTS * * *

YBR-ALT6, PUMPS @ 24,500 CFS
YAZOO BACKWATER REFORM. STUDY
Yazoo Backwater Pumping Plant
Alternate No. 5 (24,500 CFS)

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: THOMAS L. HENGST, P.E.

Preparation Date: 05/01/95
Effective Date of Pricing: 05/01/95

Sales Tax: 0.00%

M C A C E S G O L D E D I T I O N
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Release 5.30A

BASIS OF THE GOVERNMENT ESTIMATE

General:

Work performed on this project will accomplished as one item. Work involved will consist of furnishing all plant, labor, materials and equipment to construct the principal features to include: mobilization and demobilization, clearing and grubbing, channel excavation, degrading cofferdam, construction of pumping station, turfing, etc.

Operating Shifts:

Construction operations will be prosecuted in one 10-hour shift per day, six days per week.

Labor:

No difficulty is anticipated in obtaining the required crafts and laborers. It is assumed that the contractor will employ skilled personnel to operate the equipment.

The wage rates used in the estimate are the National Labor Rate Base for 1994. Overtime is computed at the rate of 16.67% of straight time based on the time worked in excess of 40 hours per week.

Employer's liability, general liability, public liability, automotive liability, property damage, and workmen's compensation insurance and social security taxes are added to labor costs for all operations.

Equipment:

Equipment rates aree based on the U. S. Army Corps of Engineers' pamphlet "Construction Equipment Ownership and Operating Expense Schedule" (EP 1110-1-8) for Region III, August 1993.

Materials:

The costs of materials and supplies are based on recent jobs using the same materials which were obtained from various distributors and current catalogs on file in Cost Engineering Branch, or from the Unit Price Book.

REASONS FOR CONTINGENCIES

Feature 09 - Channels and Canals
Feature 11 - Levees and Floodwalls
Feature 13 - Pumping Plant
Feature 19 - Buildings, Grounds and Utilities
Feature 20 - Permanent Operating Equipment

Contingencies for all items will be 15% primarily for probable variation with respect to quantities. Unit costs and the method of construction are not expected to vary greatly.

Feature 30 - Planning, Engineering and Design

The cost of this item is projected to be 11.5% of construction costs including contingencies by Project Management.

Feature 31 - Construction Management

Contingencies for this item will be 15%. The cost of this item is projected to be 10% of construction costs by Construction Division.

	QUANTY UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COST	UN
01 YBR-ALT6, PUMPS @ 24,500 CFS						
01.09 Channels and Canals						
01.09.01 Channels		3,299,144	494,872	0	3,794,015	
TOTAL Channels and Canals		3,299,144	494,872	0	3,794,015	
01.11 Levees and Floodwalls						
01.11.01 Levees		456,364	68,455	0	524,818	
01.11.02 Floodwalls		187,669	28,150	0	215,819	
TOTAL Levees and Floodwalls		644,032	96,605	0	740,637	
01.13 Pumping Plant						
01.13.00 Pumping Plant		117,598,058	17639709	0	135,237,766	
TOTAL Pumping Plant		117,598,058	17639709	0	135,237,766	
01.19 Buildings, Grounds, & Utilities						
01.19.00 Buildings, Grounds, & Utilities		570,316	85,547	0	655,864	
TOTAL Buildings, Grounds, & Utilities		570,316	85,547	0	655,864	
01.20 Permanent Operating Equipment						
01.20.00 Permanent Operating Equipment		435,000	65,250	0	500,250	
TOTAL Permanent Operating Equipment		435,000	65,250	0	500,250	
01.30 Planning, Engineering and Design		14,100,000	0	0	14,100,000	
01.31 Construction Management		12,300,000	1,845,000	0	14,145,000	
TOTAL YBR-ALT6, PUMPS @ 24,500 CFS		148,946,550	20226983	0	169,173,533	
TOTAL YBR-ALT6, PUMPS @ 24,500 CFS		148,946,550	20226983	0	169,173,533	

No errors detected...

* * * END OF ERROR REPORT * * *

No Detailed Estimate...

No Backup Reports...

* * * END TABLE OF CONTENTS * * *

MCACES
THIRD ARRAY

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE #1
Nonstructural Flood Damage Reduction Measures

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 12/01/98
Effective Date of Pricing: 10/01/98

Sales Tax: 0.00%

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	QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COS
02 Nonstruct Flood Damage Reduction						
02.01 Lands and Damages			220,406,200	40,957,800	0	261,364,000
TOTAL Nonstruct Flood Damage Reduction	1.00	EA	220,406,200	40,957,800	0	261,364,000
TOTAL YAZOO BACKWATER REFORMULATION	1.00	EA	220,406,200	40,957,800	0	261,364,000

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE #2
Nonstructural Flood Damage
Reduction Measures

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 12/01/98
Effective Date of Pricing: 10/01/98

Sales Tax: 0.00%

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		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COST
02	Nonstruct Flood Damage Reduction						
02.01	Lands and Damages			257,968,863	49,877,166	0	307,846,029
02.06	Fish and Wildlife Facilities	1.00		14,247,380	3,561,845	0	17,809,225
02.30	Planning, Engineering and Design	1.00	EA	2,130,000	532,500	0	2,662,500
02.31	Construction Management	1.00	EA	1,070,000	267,500	0	1,337,500
TOTAL	Nonstruct Flood Damage Reduction	1.00	EA	275,416,243	54,239,011	0	329,655,254
TOTAL	YAZOO BACKWATER REFORMULATION	1.00	EA	275,416,243	54,239,011	0	329,655,254

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE #3
14,000 CFS,

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 12/01/98
Effective Date of Pricing: 10/01/98

Sales Tax: 0.00%

		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COS
01	Yazoo Backwater Pumps 14,000 CFS						
01.01	Lands and Damages			115,130	28,870	0	144,000
01.02	Relocations			1,516,500	379,125	0	1,895,625
01.09	Channels and Canals			2,505,028	626,257	0	3,131,285
01.11	Levees and Floodwalls			868,048	217,012	0	1,085,061
01.13	Pumping Plant			76,349,901	16,415,229	0	92,765,130
01.19	Buildings, Grounds, & Utilities			952,002	333,201	0	1,285,203
01.20	Permanent Operating Equipment			567,227	141,807	0	709,033
01.30	Planning, Engineering and Design			10,763,579	2,690,895	0	13,454,474
01.31	Construction Management			4,579,797	1,144,949	0	5,724,746
TOTAL	Yazoo Backwater Pumps 14,000 CFS	1.00	EA	98,217,212	21,977,344	0	120,194,556
02	Nonstruct Flood Damage Reduction						
02.01	Lands and Damages			35,550,000	6,562,500	0	42,112,500
TOTAL	Nonstruct Flood Damage Reduction	1.00	EA	35,550,000	6,562,500	0	42,112,500
03	Mitigation						
03.01	Lands and Damages			17,474,300	4,200,000	0	21,674,300
03.06	Fish and Wildlife Facilities	1.00		6,030,200	1,507,550	0	7,537,750
03.30	Planning, Engineering and Design	1.00		1,230,000	307,500	0	1,537,500
03.31	Construction Management	1.00	EA	482,500	120,625	0	603,125
TOTAL	Mitigation	1.00	EA	25,217,000	6,135,675	0	31,352,675
TOTAL	YAZOO BACKWATER REFORMULATION	1.00	EA	158,984,212	34,675,519	0	193,659,731

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE #4
14,000 CFS,

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 12/01/98
Effective Date of Pricing: 10/01/98

Sales Tax: 0.00%

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		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COST
01	Yazoo Backwater Pumps 14,000 CFS						
01.01	Lands and Damages			115,130	28,870	0	144,000
01.02	Relocations			1,516,500	379,125	0	1,895,625
01.09	Channels and Canals			2,505,028	626,257	0	3,131,285
01.11	Levees and Floodwalls			868,048	217,012	0	1,085,061
01.13	Pumping Plant			76,349,901	16,415,229	0	92,765,130
01.19	Buildings, Grounds, & Utilities			1,277,995	447,298	0	1,725,293
01.20	Permanent Operating Equipment			567,227	141,807	0	709,033
01.30	Planning, Engineering and Design			10,763,579	2,690,895	0	13,454,474
01.31	Construction Management			4,579,797	1,144,949	0	5,724,746
TOTAL	Yazoo Backwater Pumps 14,000 CFS	1.00	EA	98,543,204	22,091,441	0	120,634,645
02	Nonstruct Flood Damage Reduction						
02.01	Lands and Damages			52,675,552	10,843,888	0	63,519,440
TOTAL	Nonstruct Flood Damage Reduction	1.00	EA	52,675,552	10,843,888	0	63,519,440
03	Mitigation						
03.01	Lands and Damages			14,631,700	3,520,000	0	18,151,700
03.06	Fish and Wildlife Facilities	1.00		5,037,120	1,259,280	0	6,296,400
03.30	Planning, Engineering and Design	1.00		1,028,300	257,075	0	1,285,375
03.31	Construction Management	1.00	EA	403,000	100,750	0	503,750
TOTAL	Mitigation	1.00	EA	21,100,120	5,137,105	0	26,237,225
TOTAL	YAZOO BACKWATER REFORMULATION	1.00	EA	172,318,876	38,072,434	0	210,391,310

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE #5
14,000 CFS,

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 12/01/98
Effective Date of Pricing: 10/01/98

Sales Tax: 0.00%

		QUANTY UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COS
01	Yazoo Backwater Pumps 14,000 CFS					
01.01	Lands and Damages		115,130	28,870	0	144,000
01.02	Relocations		1,516,500	379,125	0	1,895,625
01.09	Channels and Canals		2,505,028	626,257	0	3,131,285
01.11	Levees and Floodwalls		868,048	217,012	0	1,085,061
01.13	Pumping Plant		76,349,901	16,415,229	0	92,765,130
01.19	Buildings, Grounds, & Utilities		1,277,995	447,298	0	1,725,293
01.20	Permanent Operating Equipment		567,227	141,807	0	709,033
01.30	Planning, Engineering and Design		10,763,579	2,690,895	0	13,454,474
01.31	Construction Management		4,579,797	1,144,949	0	5,724,746
TOTAL	Yazoo Backwater Pumps 14,000 CFS	1.00 EA	98,543,204	22,091,441	0	120,634,645
02	Nonstruct Flood Damage Reduction					
02.01	Lands and Damages		67,246,822	14,486,705	0	81,733,527
TOTAL	Nonstruct Flood Damage Reduction	1.00 EA	67,246,822	14,486,705	0	81,733,527
03	Mitigation					
03.01	Lands and Damages		14,631,700	3,520,000	0	18,151,700
03.06	Fish and Wildlife Facilities	1.00	5,037,120	1,259,280	0	6,296,400
03.30	Planning, Engineering and Design	1.00	1,028,300	257,075	0	1,285,375
03.31	Construction Management	1.00 EA	403,000	100,750	0	503,750
TOTAL	Mitigation	1.00 EA	21,100,120	5,137,105	0	26,237,225
TOTAL	YAZOO BACKWATER REFORMULATION	1.00 EA	186,890,146	41,715,251	0	228,605,397

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE #6
14,000 CFS,

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 12/01/98
Effective Date of Pricing: 10/01/98

Sales Tax: 0.00%

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		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COST
01	Yazoo Backwater Pumps 14,000 CFS						
01.01	Lands and Damages			115,130	28,870	0	144,000
01.02	Relocations			1,516,500	379,125	0	1,895,625
01.09	Channels and Canals			2,505,028	626,257	0	3,131,285
01.11	Levees and Floodwalls			868,048	217,012	0	1,085,061
01.13	Pumping Plant			76,349,901	16,415,229	0	92,765,130
01.19	Buildings, Grounds, & Utilities			952,002	333,201	0	1,285,203
01.20	Permanent Operating Equipment			567,227	141,807	0	709,033
01.30	Planning, Engineering and Design			10,763,579	2,690,895	0	13,454,474
01.31	Construction Management			4,579,797	1,144,949	0	5,724,746
TOTAL	Yazoo Backwater Pumps 14,000 CFS	1.00	EA	98,217,212	21,977,344	0	120,194,556
02	Nonstruct Flood Damage Reduction						
02.01	Lands and Damages			46,676,010	9,344,002	0	56,020,012
02.06	Fish and Wildlife Facilities	1.00		7,417,340	1,854,335	0	9,271,675
02.30	Planning, Engineering and Design	1.00	EA	890,000	222,500	0	1,112,500
02.31	Construction Management	1.00	EA	475,000	118,750	0	593,750
TOTAL	Nonstruct Flood Damage Reduction	1.00	EA	55,458,350	11,539,587	0	66,997,937
TOTAL	YAZOO BACKWATER REFORMULATION	1.00	EA	153,675,562	33,516,931	0	187,192,493

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE #7
14,000 CFS,

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 12/01/98
Effective Date of Pricing: 10/01/98

Sales Tax: 0.00%

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		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COST
01	Yazoo Backwater Pumps 14,000 CFS						
01.01	Lands and Damages			115,130	28,870	0	144,000
01.02	Relocations			1,516,500	379,125	0	1,895,625
01.09	Channels and Canals			2,505,028	626,257	0	3,131,285
01.11	Levees and Floodwalls			868,048	217,012	0	1,085,061
01.13	Pumping Plant			76,349,901	16,415,229	0	92,765,130
01.19	Buildings, Grounds, & Utilities			1,277,995	447,298	0	1,725,293
01.20	Permanent Operating Equipment			567,227	141,807	0	709,033
01.30	Planning, Engineering and Design			10,763,579	2,690,895	0	13,454,474
01.31	Construction Management			4,579,797	1,144,949	0	5,724,746
TOTAL	Yazoo Backwater Pumps 14,000 CFS	1.00	EA	98,543,204	22,091,441	0	120,634,645
02	Nonstruct Flood Damage Reduction						
02.01	Lands and Damages			58,025,722	12,181,430	0	70,207,152
02.06	Fish and Wildlife Facilities	1.00		7,417,340	1,854,335	0	9,271,675
02.30	Planning, Engineering and Design	1.00	EA	890,000	222,500	0	1,112,500
02.31	Construction Management	1.00	EA	475,000	118,750	0	593,750
TOTAL	Nonstruct Flood Damage Reduction	1.00	EA	66,808,062	14,377,015	0	81,185,077
TOTAL	YAZOO BACKWATER REFORMULATION	1.00	EA	165,351,266	36,468,456	0	201,819,722

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE #8
14,000 CFS,

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 12/01/98
Effective Date of Pricing: 10/01/98

Sales Tax: 0.00%

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		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COST
01	Yazoo Backwater Pumps 14,000 CFS						
01.01	Lands and Damages			115,130	28,870	0	144,000
01.02	Relocations			1,516,500	379,125	0	1,895,625
01.09	Channels and Canals			2,505,028	626,257	0	3,131,285
01.11	Levees and Floodwalls			868,048	217,012	0	1,085,061
01.13	Pumping Plant			76,349,901	16,415,229	0	92,765,130
01.19	Buildings, Grounds, & Utilities			1,277,995	447,298	0	1,725,293
01.20	Permanent Operating Equipment			567,227	141,807	0	709,033
01.30	Planning, Engineering and Design			10,763,579	2,690,895	0	13,454,474
01.31	Construction Management			4,579,797	1,144,949	0	5,724,746
TOTAL	Yazoo Backwater Pumps 14,000 CFS	1.00	EA	98,543,204	22,091,441	0	120,634,645
02	Nonstruct Flood Damage Reduction						
02.01	Lands and Damages			67,246,823	14,486,706	0	81,733,529
02.06	Fish and Wildlife Facilities	1.00		7,417,340	1,854,335	0	9,271,675
02.30	Planning, Engineering and Design	1.00	EA	890,000	222,500	0	1,112,500
02.31	Construction Management	1.00	EA	475,000	118,750	0	593,750
TOTAL	Nonstruct Flood Damage Reduction	1.00	EA	76,029,163	16,682,291	0	92,711,454
TOTAL	YAZOO BACKWATER REFORMULATION	1.00	EA	174,572,367	38,773,732	0	213,346,099

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE #9
14,000 CFS,

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 12/01/98
Effective Date of Pricing: 10/01/98

Sales Tax: 0.00%

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		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COS.
01	Yazoo Backwater Pumps 14,000 CFS						
01.01	Lands and Damages			115,130	28,870	0	144,000
01.02	Relocations			1,516,500	379,125	0	1,895,625
01.09	Channels and Canals			2,505,028	626,257	0	3,131,285
01.11	Levees and Floodwalls			868,048	217,012	0	1,085,061
01.13	Pumping Plant			76,349,901	16,415,229	0	92,765,130
01.19	Buildings, Grounds, & Utilities			952,002	333,201	0	1,285,203
01.20	Permanent Operating Equipment			567,227	141,807	0	709,033
01.30	Planning, Engineering and Design			10,763,579	2,690,895	0	13,454,474
01.31	Construction Management			4,579,797	1,144,949	0	5,724,746
TOTAL	Yazoo Backwater Pumps 14,000 CFS	1.00	EA	98,217,212	21,977,344	0	120,194,556
02	Nonstruct Flood Damage Reduction						
02.01	Lands and Damages			70,353,001	14,875,750	0	85,228,751
TOTAL	Nonstruct Flood Damage Reduction	1.00	EA	70,353,001	14,875,750	0	85,228,751
03	Mitigation						
03.01	Lands and Damages	1.00	EA	10,989,100	2,640,000	0	13,629,100
03.06	Fish and Wildlife Facilities	1.00	EA	3,777,840	377,784	0	4,155,624
03.30	Planning, Engineering,and Design	1.00	EA	771,600	192,900	0	964,500
03.31	Construction Management	1.00	EA	302,200	75,550	0	377,750
TOTAL	Mitigation	1.00	EA	15,840,740	3,286,234	0	19,126,974
TOTAL	YAZOO BACKWATER REFORMULATION	1.00	EA	184,410,953	40,139,328	0	224,550,281

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE #10

14,000 CFS,

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 12/01/98
Effective Date of Pricing: 10/01/98

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		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COS
01	Yazoo Backwater Pumps 14,000 CFS						
01.01	Lands and Damages			115,130	28,870	0	144,000
01.02	Relocations			1,516,500	379,125	0	1,895,625
01.09	Channels and Canals			2,505,028	626,257	0	3,131,285
01.11	Levees and Floodwalls			868,048	217,012	0	1,085,061
01.13	Pumping Plant			76,349,901	16,415,229	0	92,765,130
01.19	Buildings, Grounds, & Utilities			1,277,995	447,298	0	1,725,293
01.20	Permanent Operating Equipment			567,227	141,807	0	709,033
01.30	Planning, Engineering and Design			10,763,579	2,690,895	0	13,454,474
01.31	Construction Management			4,579,797	1,144,949	0	5,724,746
TOTAL	Yazoo Backwater Pumps 14,000 CFS	1.00	EA	98,543,204	22,091,441	0	120,634,645
02	Nonstruct Flood Damage Reduction						
02.01	Lands and Damages			83,787,762	18,234,441	0	102,022,203
TOTAL	Nonstruct Flood Damage Reduction	1.00	EA	83,787,762	18,234,441	0	102,022,203
03	Mitigation						
03.01	Lands and Damages	1.00	EA	3,242,600	780,000	0	4,022,600
03.06	Fish and Wildlife Facilities	1.00	EA	1,126,680	271,020	0	1,397,700
03.30	Planning, Engineering,and Design	1.00	EA	230,450	57,613	0	288,063
03.31	Construction Management	1.00	EA	90,200	22,550	0	112,750
TOTAL	Mitigation	1.00	EA	4,689,930	1,131,183	0	5,821,113
TOTAL	YAZOO BACKWATER REFORMULATION	1.00	EA	187,020,896	41,457,065	0	228,477,961

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE #11
14,000 CFS,

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 12/01/98
Effective Date of Pricing: 10/01/98

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		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COST
01	Yazoo Backwater Pumps 14,000 CFS						
01.01	Lands and Damages			115,130	28,870	0	144,000
01.02	Relocations			1,516,500	379,125	0	1,895,625
01.09	Channels and Canals			2,505,028	626,257	0	3,131,285
01.11	Levees and Floodwalls			868,048	217,012	0	1,085,061
01.13	Pumping Plant			76,349,901	16,415,229	0	92,765,130
01.19	Buildings, Grounds, & Utilities			1,277,995	447,298	0	1,725,293
01.20	Permanent Operating Equipment			567,227	141,807	0	709,033
01.30	Planning, Engineering and Design			10,763,579	2,690,895	0	13,454,474
01.31	Construction Management			4,579,797	1,144,949	0	5,724,746
TOTAL	Yazoo Backwater Pumps 14,000 CFS	1.00	EA	98,543,204	22,091,441	0	120,634,645
02	Nonstruct Flood Damage Reduction						
02.01	Lands and Damages			95,820,489	21,242,623	0	117,063,112
TOTAL	Nonstruct Flood Damage Reduction	1.00	EA	95,820,489	21,242,623	0	117,063,112
03	Mitigation						
03.01	Lands and Damages	1.00	EA	3,242,600	780,000	0	4,022,600
03.06	Fish and Wildlife Facilities	1.00	EA	1,126,680	271,020	0	1,397,700
03.30	Planning, Engineering,and Design	1.00	EA	229,450	57,363	0	286,813
03.31	Construction Management	1.00	EA	90,200	22,550	0	112,750
TOTAL	Mitigation	1.00	EA	4,688,930	1,130,933	0	5,819,863
TOTAL	YAZOO BACKWATER REFORMULATION	1.00	EA	199,052,623	44,464,997	0	243,517,620

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE #12
14,000 CFS,

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 12/01/98
Effective Date of Pricing: 10/01/98

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		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COS,
01	Yazoo Backwater Pumps 14,000 CFS						
01.01	Lands and Damages			115,130	28,870	0	144,000
01.02	Relocations			1,516,500	379,125	0	1,895,625
01.09	Channels and Canals			2,505,028	626,257	0	3,131,285
01.11	Levees and Floodwalls			868,048	217,012	0	1,085,061
01.13	Pumping Plant			76,349,901	16,415,229	0	92,765,130
01.19	Buildings, Grounds, & Utilities			952,002	333,201	0	1,285,203
01.20	Permanent Operating Equipment			567,227	141,807	0	709,033
01.30	Planning, Engineering and Design			10,763,579	2,690,895	0	13,454,474
01.31	Construction Management			4,579,797	1,144,949	0	5,724,746
TOTAL	Yazoo Backwater Pumps 14,000 CFS	1.00	EA	98,217,212	21,977,344	0	120,194,556
02	Nonstruct Flood Damage Reduction						
02.01	Lands and Damages			110,423,758	24,893,439	0	135,317,197
02.06	Fish and Wildlife Facilities	1.00		14,247,380	3,561,845	0	17,809,225
02.30	Planning, Engineering and Design	1.00	EA	1,710,000	427,500	0	2,137,500
02.31	Construction Management	1.00	EA	911,000	227,750	0	1,138,750
TOTAL	Nonstruct Flood Damage Reduction	1.00	EA	127,292,138	29,110,534	0	156,402,67ᴄ
TOTAL	YAZOO BACKWATER REFORMULATION	1.00	EA	225,509,350	51,087,878	0	276,597,228

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE #13
14,000 CFS,

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 12/01/98
Effective Date of Pricing: 10/01/98

Sales Tax: 0.00%

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		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COS
01	Yazoo Backwater Pumps 14,000 CFS						
01.01	Lands and Damages			115,130	28,870	0	144,000
01.02	Relocations			1,516,500	379,125	0	1,895,625
01.09	Channels and Canals			2,505,028	626,257	0	3,131,285
01.11	Levees and Floodwalls			868,048	217,012	0	1,085,061
01.13	Pumping Plant			76,349,901	16,415,229	0	92,765,130
01.19	Buildings, Grounds, & Utilities			1,277,995	447,298	0	1,725,293
01.20	Permanent Operating Equipment			567,227	141,807	0	709,033
01.30	Planning, Engineering and Design			10,763,579	2,690,895	0	13,454,474
01.31	Construction Management			4,579,797	1,144,949	0	5,724,746
TOTAL	Yazoo Backwater Pumps 14,000 CFS	1.00	EA	98,543,204	22,091,441	0	120,634,645
02	Nonstruct Flood Damage Reduction						
02.01	Lands and Damages			113,418,699	25,642,175	0	139,060,874
02.06	Fish and Wildlife Facilities	1.00		14,247,380	3,561,845	0	17,809,225
02.30	Planning, Engineering and Design	1.00	EA	1,710,000	427,500	0	2,137,500
02.31	Construction Management	1.00	EA	911,000	227,750	0	1,138,750
TOTAL	Nonstruct Flood Damage Reduction	1.00	EA	130,287,079	29,859,270	0	160,146,34.
TOTAL	YAZOO BACKWATER REFORMULATION	1.00	EA	228,830,283	51,950,711	0	280,780,994

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE #14
14,000 CFS,

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 12/01/98
Effective Date of Pricing: 10/01/98

Sales Tax: 0.00%

		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COS.
01	Yazoo Backwater Pumps 14,000 CFS						
01.01	Lands and Damages			115,130	28,870	0	144,000
01.02	Relocations			1,516,500	379,125	0	1,895,625
01.09	Channels and Canals			2,505,028	626,257	0	3,131,285
01.11	Levees and Floodwalls			868,048	217,012	0	1,085,061
01.13	Pumping Plant			76,349,901	16,415,229	0	92,765,130
01.19	Buildings, Grounds, & Utilities			1,277,995	447,298	0	1,725,293
01.20	Permanent Operating Equipment			567,227	141,807	0	709,033
01.30	Planning, Engineering and Design			10,763,579	2,690,895	0	13,454,474
01.31	Construction Management			4,579,797	1,144,949	0	5,724,746
TOTAL	Yazoo Backwater Pumps 14,000 CFS	1.00	EA	98,543,204	22,091,441	0	120,634,645
02	Nonstruct Flood Damage Reduction						
02.01	Lands and Damages			115,029,976	26,044,994	0	141,074,970
02.06	Fish and Wildlife Facilities	1.00		14,247,380	3,561,845	0	17,809,225
02.30	Planning, Engineering and Design	1.00	EA	1,710,000	427,500	0	2,137,500
02.31	Construction Management	1.00	EA	911,000	227,750	0	1,138,750
TOTAL	Nonstruct Flood Damage Reduction	1.00	EA	131,898,356	30,262,089	0	162,160,445
TOTAL	YAZOO BACKWATER REFORMULATION	1.00	EA	230,441,560	52,353,530	0	282,795,090

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE #15
17,500 CFS,

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 12/01/98
Effective Date of Pricing: 10/01/98

Sales Tax: 0.00%

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		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COST
01	Yazoo Backwater Pumps 17,500 CFS						
01.01	Lands and Damages			115,130	28,870	0	144,000
01.02	Relocations	1.00	EA	1,516,500	379,125	0	1,895,625
01.09	Channels and Canals	1.00		2,801,971	700,493	0	3,502,464
01.11	Levees and Floodwalls			881,108	220,277	0	1,101,385
01.13	Pumping Plant	1.00		87,508,317	25377412	0	112,885,729
01.19	Buildings, Grounds, & Utilities			968,137	338,848	0	1,306,986
01.20	Permanent Operating Equipment			576,841	201,894	0	778,735
01.30	Planning, Engineering and Design			12,252,875	3,063,219	0	15,316,094
01.31	Construction Management			5,183,910	1,295,978	0	6,479,888
TOTAL	Yazoo Backwater Pumps 17,500 CFS	1.00	EA	111,804,789	31606115	0	143,410,904
02	Nonstruct Flood Damage Reduction						
02.01	Lands and Damages			35,550,000	6,562,500	0	42,112,500
TOTAL	Nonstruct Flood Damage Reduction	1.00	EA	35,550,000	6,562,500	0	42,112,500
03	Mitigation						
03.01	Lands and Damages			19,055,600	4,580,000	0	23,635,600
03.06	Fish and Wildlife Facilities	1.00		6,584,480	1,646,120	0	8,230,600
03.30	Planning, Engineering and Design	1.00		1,342,750	335,688	0	1,678,438
03.31	Construction Management	1.00	EA	527,000	131,750	0	658,750
TOTAL	Mitigation	1.00	EA	27,509,830	6,693,557	0	34,203,388
TOTAL	YAZOO BACKWATER REFORMULATION	1.00	EA	174,864,619	44862172	0	219,726,792

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE #16
17,500 CFS,

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 12/01/98
Effective Date of Pricing: 10/01/98

Sales Tax: 0.00%

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		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COS.
01	Yazoo Backwater Pumps 17,500 CFS						
01.01	Lands and Damages			115,130	28,870	0	144,000
01.02	Relocations	1.00	EA	1,516,500	379,125	0	1,895,625
01.09	Channels and Canals	1.00		2,801,971	700,493	0	3,502,464
01.11	Levees and Floodwalls			881,108	220,277	0	1,101,385
01.13	Pumping Plant	1.00		87,508,317	25377412	0	112,885,729
01.19	Buildings, Grounds, & Utilities			1,299,655	454,879	0	1,754,534
01.20	Permanent Operating Equipment			576,841	201,894	0	778,735
01.30	Planning, Engineering and Design			12,252,875	3,063,219	0	15,316,094
01.31	Construction Management			5,183,910	1,295,978	0	6,479,888
TOTAL	Yazoo Backwater Pumps 17,500 CFS	1.00	EA	112,136,307	31722146	0	143,858,453
02	Nonstruct Flood Damage Reduction						
02.01	Lands and Damages			52,675,553	10843888	0	63,519,441
TOTAL	Nonstruct Flood Damage Reduction	1.00	EA	52,675,553	10843888	0	63,519,441
03	Mitigation						
03.01	Lands and Damages			16,293,000	3,920,000	0	20,213,000
03.06	Fish and Wildlife Facilities	1.00		5,609,520	1,402,380	0	7,011,900
03.30	Planning, Engineering and Design	1.00		1,145,300	286,325	0	1,431,625
03.31	Construction Management	1.00	EA	448,750	112,188	0	560,938
TOTAL	Mitigation	1.00	EA	23,496,570	5,720,893	0	29,217,463
TOTAL	YAZOO BACKWATER REFORMULATION	1.00	EA	188,308,430	48286926	0	236,595,356

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE #17
17,500 CFS,

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 12/01/98
Effective Date of Pricing: 10/01/98

Sales Tax: 0.00%

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		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COST
01	Yazoo Backwater Pumps 17,500 CFS						
01.01	Lands and Damages			115,130	28,870	0	144,000
01.02	Relocations	1.00	EA	1,516,500	379,125	0	1,895,625
01.09	Channels and Canals	1.00		2,801,971	700,493	0	3,502,464
01.11	Levees and Floodwalls			881,108	220,277	0	1,101,385
01.13	Pumping Plant	1.00		87,508,317	25377412	0	112,885,729
01.19	Buildings, Grounds, & Utilities			1,299,655	454,879	0	1,754,534
01.20	Permanent Operating Equipment			576,841	201,894	0	778,735
01.30	Planning, Engineering and Design			12,252,875	3,063,219	0	15,316,094
01.31	Construction Management			5,183,910	1,295,978	0	6,479,888
TOTAL	Yazoo Backwater Pumps 17,500 CFS	1.00	EA	112,136,307	31722146	0	143,858,453
02	Nonstruct Flood Damage Reduction						
02.01	Lands and Damages			67,246,823	14486706	0	81,733,529
TOTAL	Nonstruct Flood Damage Reduction	1.00	EA	67,246,823	14486706	0	81,733,529
03	Mitigation						
03.01	Lands and Damages			16,293,000	3,920,000	0	20,213,000
03.06	Fish and Wildlife Facilities	1.00		5,609,520	1,402,380	0	7,011,900
03.30	Planning, Engineering and Design	1.00		1,145,300	286,325	0	1,431,625
03.31	Construction Management	1.00	EA	448,750	112,188	0	560,938
TOTAL	Mitigation	1.00	EA	23,496,570	5,720,893	0	29,217,463
TOTAL	YAZOO BACKWATER REFORMULATION	1.00	EA	202,879,700	51929744	0	254,809,444

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE #18
17,500 CFS,

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 12/01/98
Effective Date of Pricing: 10/01/98

Sales Tax: 0.00%

		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COST
01	Yazoo Backwater Pumps 17,500 CFS						
01.01	Lands and Damages			115,130	28,870	0	144,000
01.02	Relocations	1.00	EA	1,516,500	379,125	0	1,895,625
01.09	Channels and Canals	1.00		2,801,971	700,493	0	3,502,464
01.11	Levees and Floodwalls			881,108	220,277	0	1,101,385
01.13	Pumping Plant	1.00		87,508,317	25377412	0	112,885,729
01.19	Buildings, Grounds, & Utilities			968,137	338,848	0	1,306,986
01.20	Permanent Operating Equipment			576,841	201,894	0	778,735
01.30	Planning, Engineering and Design			12,252,875	3,063,219	0	15,316,094
01.31	Construction Management			5,183,910	1,295,978	0	6,479,888
TOTAL	Yazoo Backwater Pumps 17,500 CFS	1.00	EA	111,804,789	31606115	0	143,410,904
02	Nonstruct Flood Damage Reduction						
02.01	Lands and Damages			46,676,010	9,344,002	0	56,020,012
02.06	Fish and Wildlife Facilities	1.00		7,417,340	1,854,335	0	9,271,675
02.30	Planning, Engineering and Design	1.00	EA	890,000	222,500	0	1,112,500
02.31	Construction Management	1.00	EA	475,000	118,750	0	593,750
TOTAL	Nonstruct Flood Damage Reduction	1.00	EA	55,458,350	11539587	0	66,997,937
TOTAL	YAZOO BACKWATER REFORMULATION	1.00	EA	167,263,139	43145702	0	210,408,841

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE #19
17,500 CFS,

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 12/01/98
Effective Date of Pricing: 10/01/98

Sales Tax: 0.00%

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		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COS
01	Yazoo Backwater Pumps 17,500 CFS						
01.01	Lands and Damages			115,130	28,870	0	144,000
01.02	Relocations	1.00	EA	1,516,500	379,125	0	1,895,625
01.09	Channels and Canals	1.00		2,801,971	700,493	0	3,502,464
01.11	Levees and Floodwalls			881,108	220,277	0	1,101,385
01.13	Pumping Plant	1.00		87,508,317	25377412	0	112,885,729
01.19	Buildings, Grounds, & Utilities			1,299,655	454,879	0	1,754,534
01.20	Permanent Operating Equipment			576,841	201,894	0	778,735
01.30	Planning, Engineering and Design			12,252,875	3,063,219	0	15,316,094
01.31	Construction Management			5,183,910	1,295,978	0	6,479,888
TOTAL	Yazoo Backwater Pumps 17,500 CFS	1.00	EA	112,136,307	31722146	0	143,858,453
02	Nonstruct Flood Damage Reduction						
02.01	Lands and Damages			58,025,723	12181431	0	70,207,154
02.06	Fish and Wildlife Facilities	1.00		7,417,340	1,854,335	0	9,271,675
02.30	Planning, Engineering and Design	1.00	EA	890,000	222,500	0	1,112,500
02.31	Construction Management	1.00	EA	475,000	118,750	0	593,750
TOTAL	Nonstruct Flood Damage Reduction	1.00	EA	66,808,063	14377016	0	81,185,07
TOTAL	YAZOO BACKWATER REFORMULATION	1.00	EA	178,944,370	46099162	0	225,043,532

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE #20
17,500 CFS,

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 12/01/98
Effective Date of Pricing: 10/01/98

Sales Tax: 0.00%

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		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COST
01	Yazoo Backwater Pumps 17,500 CFS						
01.01	Lands and Damages			115,130	28,870	0	144,000
01.02	Relocations	1.00	EA	1,516,500	379,125	0	1,895,625
01.09	Channels and Canals	1.00		2,801,971	700,493	0	3,502,464
01.11	Levees and Floodwalls			881,108	220,277	0	1,101,385
01.13	Pumping Plant	1.00		87,508,317	25377412	0	112,885,729
01.19	Buildings, Grounds, & Utilities			1,299,655	454,879	0	1,754,534
01.20	Permanent Operating Equipment			576,841	201,894	0	778,735
01.30	Planning, Engineering and Design			12,252,875	3,063,219	0	15,316,094
01.31	Construction Management			5,183,910	1,295,978	0	6,479,888
TOTAL	Yazoo Backwater Pumps 17,500 CFS	1.00	EA	112,136,307	31722146	0	143,858,453
02	Nonstruct Flood Damage Reduction						
02.01	Lands and Damages			67,246,823	14486706	0	81,733,529
02.06	Fish and Wildlife Facilities	1.00		7,417,340	1,854,335	0	9,271,675
02.30	Planning, Engineering and Design	1.00	EA	890,000	222,500	0	1,112,500
02.31	Construction Management	1.00	EA	475,000	118,750	0	593,750
TOTAL	Nonstruct Flood Damage Reduction	1.00	EA	76,029,163	16682291	0	92,711,454
TOTAL	YAZOO BACKWATER REFORMULATION	1.00	EA	188,165,470	48404437	0	236,569,907

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE #21
17,500 CFS,

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 12/01/98
Effective Date of Pricing: 10/01/98

Sales Tax: 0.00%

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		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COST
01	Yazoo Backwater Pumps 17,500 CFS						
01.01	Lands and Damages			115,130	28,870	0	144,000
01.02	Relocations	1.00	EA	1,516,500	379,125	0	1,895,625
01.09	Channels and Canals	1.00		2,801,971	700,493	0	3,502,464
01.11	Levees and Floodwalls			881,108	220,277	0	1,101,385
01.13	Pumping Plant	1.00		87,508,317	25377412	0	112,885,729
01.19	Buildings, Grounds, & Utilities			968,137	338,848	0	1,306,986
01.20	Permanent Operating Equipment			576,841	201,894	0	778,735
01.30	Planning, Engineering and Design			12,252,875	3,063,219	0	15,316,094
01.31	Construction Management			5,183,910	1,295,978	0	6,479,888
TOTAL	Yazoo Backwater Pumps 17,500 CFS	1.00	EA	111,804,789	31606115	0	143,410,904
02	Nonstruct Flood Damage Reduction						
02.01	Lands and Damages			70,353,001	14875750	0	85,228,751
TOTAL	Nonstruct Flood Damage Reduction	1.00	EA	70,353,001	14875750	0	85,228,751
03	Mitigation						
03.01	Lands and Damages	1.00	EA	12,730,400	3,060,000	0	15,790,400
03.06	Fish and Wildlife Facilities	1.00	EA	4,409,360	1,059,876	0	5,469,236
03.30	Planning, Engineering,and Design	1.00	EA	898,550	224,638	0	1,123,188
03.31	Construction Management	1.00	EA	352,750	88,188	0	440,938
TOTAL	Mitigation	1.00	EA	18,391,060	4,432,701	0	22,823,761
TOTAL	YAZOO BACKWATER REFORMULATION	1.00	EA	200,548,850	50914565	0	251,463,416

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE #22
17,500 CFS,

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 12/01/98
Effective Date of Pricing: 10/01/98

Sales Tax: 0.00%

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		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COST
01	Yazoo Backwater Pumps 17,500 CFS						
01.01	Lands and Damages			115,130	28,870	0	144,000
01.02	Relocations	1.00	EA	1,516,500	379,125	0	1,895,625
01.09	Channels and Canals	1.00		2,801,971	700,493	0	3,502,464
01.11	Levees and Floodwalls			881,108	220,277	0	1,101,385
01.13	Pumping Plant	1.00		87,508,317	25377412	0	112,885,729
01.19	Buildings, Grounds, & Utilities			1,299,655	454,879	0	1,754,534
01.20	Permanent Operating Equipment			576,841	201,894	0	778,735
01.30	Planning, Engineering and Design			12,252,875	3,063,219	0	15,316,094
01.31	Construction Management			5,183,910	1,295,978	0	6,479,888
TOTAL	Yazoo Backwater Pumps 17,500 CFS	1.00	EA	112,136,307	31722146	0	143,858,453
02	Nonstruct Flood Damage Reduction						
02.01	Lands and Damages			83,787,762	18234440	0	102,022,202
TOTAL	Nonstruct Flood Damage Reduction	1.00	EA	83,787,762	18234440	0	102,022,202
03	Mitigation						
03.01	Lands and Damages	1.00	EA	4,103,900	980,000	0	5,083,900
03.02	Fish and Wildlife Facilities	1.00	EA	1,436,880	343,123	0	1,780,003
03.30	Planning, Engineering,and Design	1.00	EA	291,450	72,863	0	364,313
03.31	Construction Management	1.00	EA	115,000	28,750	0	143,750
TOTAL	Mitigation	1.00	EA	5,947,230	1,424,735	0	7,371,965
TOTAL	YAZOO BACKWATER REFORMULATION	1.00	EA	201,871,299	51381321	0	253,252,620

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE #23
17,500 CFS,

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 12/01/98
Effective Date of Pricing: 10/01/98

Sales Tax: 0.00%

		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COS
01	Yazoo Backwater Pumps 17,500 CFS						
01.01	Lands and Damages			115,130	28,870	0	144,000
01.02	Relocations	1.00	EA	1,516,500	379,125	0	1,895,625
01.09	Channels and Canals	1.00		2,801,971	700,493	0	3,502,464
01.11	Levees and Floodwalls			881,108	220,277	0	1,101,385
01.13	Pumping Plant	1.00		87,508,317	25377412	0	112,885,729
01.19	Buildings, Grounds, & Utilities			1,299,655	454,879	0	1,754,534
01.20	Permanent Operating Equipment			576,841	201,894	0	778,735
01.30	Planning, Engineering and Design			12,252,875	3,063,219	0	15,316,094
01.31	Construction Management			5,183,910	1,295,978	0	6,479,888
TOTAL	Yazoo Backwater Pumps 17,500 CFS	1.00	EA	112,136,307	31722146	0	143,858,453
02	Nonstruct Flood Damage Reduction						
02.01	Lands and Damages			95,820,489	21242622	0	117,063,111
TOTAL	Nonstruct Flood Damage Reduction	1.00	EA	95,820,489	21242622	0	117,063,111
03	Mitigation						
03.01	Lands and Damages	1.00	EA	4,103,900	980,000	0	5,083,900
03.06	Fish and Wildlife Facilities	1.00	EA	1,436,880	143,688	0	1,580,568
03.30	Planning, Engineering,and Design	1.00	EA	291,450	72,863	0	364,313
03.31	Construction Management	1.00	EA	115,000	28,750	0	143,750
TOTAL	Mitigation	1.00	EA	5,947,230	1,225,301	0	7,172,531
TOTAL	YAZOO BACKWATER REFORMULATION	1.00	EA	213,904,026	54190068	0	268,094,094

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE #24
17,500 CFS,

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 12/01/98
Effective Date of Pricing: 10/01/98

Sales Tax: 0.00%

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		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COST
01	Yazoo Backwater Pumps 17,500 CFS						
01.01	Lands and Damages			115,130	28,870	0	144,000
01.02	Relocations	1.00	EA	1,516,500	379,125	0	1,895,625
01.09	Channels and Canals	1.00		2,801,971	700,493	0	3,502,464
01.11	Levees and Floodwalls			881,108	220,277	0	1,101,385
01.13	Pumping Plant	1.00		87,508,317	25377412	0	112,885,729
01.19	Buildings, Grounds, & Utilities			968,137	338,848	0	1,306,986
01.20	Permanent Operating Equipment			576,841	201,894	0	778,735
01.30	Planning, Engineering and Design			12,252,875	3,063,219	0	15,316,094
01.31	Construction Management			5,183,910	1,295,978	0	6,479,888
TOTAL	Yazoo Backwater Pumps 17,500 CFS	1.00	EA	111,804,789	31606115	0	143,410,904
02	Nonstruct Flood Damage Reduction						
02.01	Lands and Damages			110,423,757	24893439	0	135,317,196
02.06	Fish and Wildlife Facilities	1.00		14,247,380	3,561,845	0	17,809,225
02.30	Planning, Engineering and Design	1.00	EA	1,710,000	427,500	0	2,137,500
02.31	Construction Management	1.00	EA	912,000	228,000	0	1,140,000
TOTAL	Nonstruct Flood Damage Reduction	1.00	EA	127,293,137	29110784	0	156,403,921
TOTAL	YAZOO BACKWATER REFORMULATION	1.00	EA	239,097,926	60716899	0	299,814,825

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE #25
17,500 CFS,

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 12/01/98
Effective Date of Pricing: 10/01/98

Sales Tax: 0.00%

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		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COS
01	Yazoo Backwater Pumps 17,500 CFS						
01.01	Lands and Damages			115,130	28,870	0	144,000
01.02	Relocations	1.00	EA	1,516,500	379,125	0	1,895,625
01.09	Channels and Canals	1.00		2,801,971	700,493	0	3,502,464
01.11	Levees and Floodwalls			881,108	220,277	0	1,101,385
01.13	Pumping Plant	1.00		87,508,317	25377412	0	112,885,729
01.19	Buildings, Grounds, & Utilities			1,299,655	454,879	0	1,754,534
01.20	Permanent Operating Equipment			576,841	201,894	0	778,735
01.30	Planning, Engineering and Design			12,252,875	3,063,219	0	15,316,094
01.31	Construction Management			5,183,910	1,295,978	0	6,479,888
TOTAL	Yazoo Backwater Pumps 17,500 CFS	1.00	EA	112,136,307	31722146	0	143,858,453
02	Nonstruct Flood Damage Reduction						
02.01	Lands and Damages			113,418,699	25642175	0	139,060,874
02.06	Fish and Wildlife Facilities	1.00		14,247,380	3,561,845	0	17,809,225
02.30	Planning, Engineering and Design	1.00	EA	1,710,000	427,500	0	2,137,500
02.31	Construction Management	1.00	EA	912,000	228,000	0	1,140,000
TOTAL	Nonstruct Flood Damage Reduction	1.00	EA	130,288,079	29859520	0	160,147,59.
TOTAL	YAZOO BACKWATER REFORMULATION	1.00	EA	242,424,386	61581666	0	304,006,052

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE #26
17,500 CFS,

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 12/01/98
Effective Date of Pricing: 10/01/98

Sales Tax: 0.00%

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		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COST
01	Yazoo Backwater Pumps 17,500 CFS						
01.01	Lands and Damages			115,130	28,870	0	144,000
01.02	Relocations	1.00	EA	1,516,500	379,125	0	1,895,625
01.09	Channels and Canals	1.00		2,801,971	700,493	0	3,502,464
01.11	Levees and Floodwalls			881,108	220,277	0	1,101,385
01.13	Pumping Plant	1.00		87,508,317	25377412	0	112,885,729
01.19	Buildings, Grounds, & Utilities			1,299,655	454,879	0	1,754,534
01.20	Permanent Operating Equipment			576,841	201,894	0	778,735
01.30	Planning, Engineering and Design			12,252,875	3,063,219	0	15,316,094
01.31	Construction Management			5,183,910	1,295,978	0	6,479,888
TOTAL	Yazoo Backwater Pumps 17,500 CFS	1.00	EA	112,136,307	31722146	0	143,858,453
02	Nonstruct Flood Damage Reduction						
02.01	Lands and Damages			115,029,976	26044994	0	141,074,970
02.06	Fish and Wildlife Facilities	1.00		14,247,380	3,561,845	0	17,809,225
02.30	Planning, Engineering and Design	1.00	EA	1,710,000	427,500	0	2,137,500
02.31	Construction Management	1.00	EA	912,000	228,000	0	1,140,000
TOTAL	Nonstruct Flood Damage Reduction	1.00	EA	131,899,356	30262339	0	162,161,695
TOTAL	YAZOO BACKWATER REFORMULATION	1.00	EA	244,035,663	61984485	0	306,020,148

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE #27
14,000 CFS,

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 12/01/98
Effective Date of Pricing: 10/01/98

Sales Tax: 0.00%

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		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COS.
01	Yazoo Backwater Pumps 14,000 CFS						
01.01	Lands and Damages			115,130	28,870	0	144,000
01.02	Relocations			1,516,500	379,125	0	1,895,625
01.09	Channels and Canals			2,505,028	626,257	0	3,131,285
01.11	Levees and Floodwalls			868,048	217,012	0	1,085,061
01.13	Pumping Plant			76,349,901	16,415,229	0	92,765,130
01.19	Buildings, Grounds, & Utilities			952,002	333,201	0	1,285,203
01.20	Permanent Operating Equipment			567,227	141,807	0	709,033
01.30	Planning, Engineering and Design			10,763,579	2,690,895	0	13,454,474
01.31	Construction Management			4,579,797	1,144,949	0	5,724,746
TOTAL	Yazoo Backwater Pumps 14,000 CFS	1.00	EA	98,217,212	21,977,344	0	120,194,556
03	Mitigation						
03.01	Lands and Damages			22,730,500	5,300,000	0	28,030,500
03.06	Fish and Wildlife Facilities	1.00		7,784,640	1,946,160	0	9,730,800
03.30	Planning, Engineering and Design	1.00		1,591,600	397,900	0	1,989,500
03.31	Construction Management	1.00	EA	623,000	155,750	0	778,750
TOTAL	Mitigation	1.00	EA	32,729,740	7,799,810	0	40,529,550
TOTAL	YAZOO BACKWATER REFORMULATION	1.00	EA	130,946,952	29,777,154	0	160,724,106

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE #28
17,500 CFS,

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 12/01/98
Effective Date of Pricing: 10/01/98

Sales Tax: 0.00%

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		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COS
01	Yazoo Backwater Pumps 17,500 CFS						
01.01	Lands and Damages			115,130	28,870	0	144,000
01.02	Relocations	1.00	EA	1,516,500	379,125	0	1,895,625
01.09	Channels and Canals	1.00		2,801,971	700,493	0	3,502,464
01.11	Levees and Floodwalls			881,108	220,277	0	1,101,385
01.13	Pumping Plant	1.00		87,508,317	25377412	0	112,885,729
01.19	Buildings, Grounds, & Utilities			968,137	338,848	0	1,306,986
01.20	Permanent Operating Equipment			576,841	201,894	0	778,735
01.30	Planning, Engineering and Design			12,252,875	3,063,219	0	15,316,094
01.31	Construction Management			5,183,910	1,295,978	0	6,479,888
TOTAL	Yazoo Backwater Pumps 17,500 CFS	1.00	EA	111,804,789	31606115	0	143,410,904
03	Mitigation						
03.01	Lands and Damages			26,973,100	6,380,000	0	33,353,100
03.06	Fish and Wildlife Facilities	1.00		9,266,880	2,316,720	0	11,583,600
03.30	Planning, Engineering and Design	1.00		1,892,232	473,058	0	2,365,290
03.31	Construction Management	1.00	EA	741,350	185,338	0	926,688
TOTAL	Mitigation	1.00	EA	38,873,562	9,355,116	0	48,228,67[illegible]
TOTAL	YAZOO BACKWATER REFORMULATION	1.00	EA	150,678,351	40961230	0	191,639,582

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE 29
SUNFLOWER /LITTLE SUNFLOWER
LEVEE SYSTEM

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 12/01/98
Effective Date of Pricing: 10/01/98

Sales Tax: 0.00%

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		QUANTY	UOM	CONTRACT COST	CONTINGN	TOTAL COS.
01	LEVEE (WEST SIDE)					
01.01	Lands and Damages	1.00	EA	14,710,318	1,784,730	16,495,048
01.02	Relocations	1.00		804,096	201,024	1,005,120
01.11	Levees	1.00	EA	56,129,812	14,032,453	70,162,265
01.15	Floodway Control-Diversion Struc			13,433,170	3,358,293	16,791,463
01.30	Planning, Engineering and Design			15,506,028	3,876,507	19,382,535
01.31	Construction Management			8,009,212	2,002,303	10,011,515
TOTAL	LEVEE (WEST SIDE)	1.00	EA	108,592,637	25,255,310	133,847,946
02	LEVEE (EAST SIDE)					
02.01	Lands and Damages	1.00	EA	7,939,307	961,008	8,900,315
02.02	Relocations	1.00		1,019,856	254,964	1,274,820
02.11	Levees	1.00	EA	28,445,292	7,111,323	35,556,615
02.15	Floodway Control-Diversion Struc			13,592,194	3,398,048	16,990,242
02.30	Planning, Engineering and Design			9,866,110	2,466,528	12,332,638
02.31	Construction Management			4,935,749	1,233,937	6,169,686
TOTAL	LEVEE (EAST SIDE)	1.00	EA	65,798,508	15,425,808	81,224,31
03	MITIGATION					
03.01	Lands and Damages			10,749,100	3,000,000	13,749,100
03.06	Fish and Wildlife Facilities	1.00		3,722,480	372,248	4,094,728
03.30	Planning, Engineering and Design			758,950	189,738	948,688
03.31	Construction Management			298,000	74,500	372,500
TOTAL	MITIGATION			15,528,530	3,636,486	19,165,016
TOTAL	YAZOO BACKWATER REFORMULATION	1.00	EA	189,919,674	44,317,603	234,237,278

YAZOO BACKWATER REFORMULATION
THIRD ARRAY, ALTERNATIVE #30
14,000 CFS,

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: DAVID G. JENKINS

Preparation Date: 10/01/98
Effective Date of Pricing: 10/01/98

Sales Tax: 0.00%

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		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COS.
01	Yazoo Backwater Pumps 14,000 CFS						
01.01	Lands and Damages			115,130	28,870	0	144,000
01.02	Relocations			1,516,500	379,125	0	1,895,625
01.09	Channels and Canals			2,505,028	626,257	0	3,131,285
01.11	Levees and Floodwalls			868,048	217,012	0	1,085,061
01.13	Pumping Plant			76,349,901	16,415,229	0	92,765,130
01.19	Buildings, Grounds, & Utilities			952,002	333,201	0	1,285,203
01.20	Permanent Operating Equipment			567,227	141,807	0	709,033
01.30	Planning, Engineering and Design			10,763,579	2,690,895	0	13,454,474
01.31	Construction Management			4,579,797	1,144,949	0	5,724,746
TOTAL	Yazoo Backwater Pumps 14,000 CFS	1.00	EA	98,217,212	21,977,344	0	120,194,556
02	Nonstruct Flood Damage Reduction						
02.01	Lands and Damages			63,255,315	10,001,329	0	73,256,644
TOTAL	Nonstruct Flood Damage Reduction	1.00	EA	63,255,315	10,001,329	0	73,256,644
03	Mitigation						
03.01	Lands and Damages			22,679,500	5,440,000	0	28,119,500
03.06	Fish and Wildlife Facilities	1.00		7,786,640	778,664	0	8,565,304
03.30	Planning, Engineering and Design	1.00		1,591,600	397,900	0	1,989,500
03.31	Construction Management	1.00	EA	622,931	155,733	0	778,664
TOTAL	Mitigation	1.00	EA	32,680,671	6,772,297	0	39,452,968
TOTAL	YAZOO BACKWATER REFORMULATION	1.00	EA	194,153,198	38,750,969	0	232,904,167

MCACES
FINAL ARRAY

YAZOO BACKWATER PUMP PLAN #2
FINAL ARRAY OF ALTERNATIVIES
NONSTRUCTURAL FLOOD DAMAGE
REDUCTION MEASURES

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: PHILLIP G. HEGWOOD

Preparation Date: 02/11/00
Effective Date of Pricing: 10/01/00

Sales Tax: 0.00%

	QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COS.
01 Non-Struc Flood Damage Reduction						
01.01 Lands and Damages			225,438,430	42,215,858	0	267,654,288
01.06 Fish and Wildlife Facilities			14,980,000	1,498,000	0	16,478,000
01.30 Planning, Engineering and Design			5,495,000	1,373,750	0	6,868,750
TOTAL Non-Struc Flood Damage Reduction			245,913,430	45,087,608	0	291,001,038
TOTAL YAZOO BACKWATER PUMP PLAN #2	1.00	EA	245,913,430	45,087,608	0	291,001,038

YAZOO BACKWATER PUMP PLAN #3
FINAL ARRAY OF ALTERNATIVIES
14,000 CFS, AND MITIGATION

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: PHILLIP G. HEGWOOD

Preparation Date: 02/11/00
Effective Date of Pricing: 10/01/00

Sales Tax: 0.00%

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		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COS
01	Yazoo Backwater Pumps 14,000 CFS						
01.01	Lands and Damages			105,130	26,370	0	131,500
01.02	Relocations			1,516,500	151,650	0	1,668,150
01.09	Channels and Canals			2,505,028	375,754	0	2,880,782
01.11	Levees and Floodwalls			868,048	130,207	0	998,256
01.13	Pumping Plant			76,349,901	12,184,298	0	88,534,199
01.19	Buildings, Grounds, & Utilities			952,002	190,400	0	1,142,403
01.20	Permanent Operating Equipment			567,227	102,101	0	669,328
01.30	Planning, Engineering and Design			10,763,579	2,690,895	0	13,454,474
01.31	Construction Management			4,602,869	1,150,717	0	5,753,586
TOTAL	Yazoo Backwater Pumps 14,000 CFS			98,230,284	17,002,392	0	115,232,676
03	Mitigation						
03.01	Lands and Damages			22,711,500	5,448,000	0	28,159,500
03.06	Fish and Wildlife Facilities			7,792,300	779,230	0	8,571,530
03.30	Planning, Engineering and Design			1,397,000	349,250	0	1,746,250
TOTAL	Mitigation			31,900,800	6,576,480	0	38,477,28[illegible]
TOTAL	YAZOO BACKWATER PUMP PLAN #3	1.00	EA	130,131,084	23,578,872	0	153,709,956

YAZOO BACKWATER PUMP PLAN #4
FINAL ARRAY OF ALTERNATIVIES
14,000 CFS, AND NONSTRUCTURAL
FLOOD DAMAGE REDUCTION MEASURES

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: PHILLIP G. HEGWOOD

Preparation Date: 02/11/00
Effective Date of Pricing: 10/01/00

Sales Tax: 0.00%

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		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COS
01	Yazoo Backwater Pumps 14,000 CFS						
01.01	Lands and Damages			105,130	26,370	0	131,500
01.02	Relocations			1,516,500	151,650	0	1,668,150
01.09	Channels and Canals			2,505,028	375,754	0	2,880,782
01.11	Levees and Floodwalls			868,048	130,207	0	998,256
01.13	Pumping Plant			76,349,901	12,184,298	0	88,534,199
01.19	Buildings, Grounds, & Utilities			952,002	190,400	0	1,142,403
01.20	Permanent Operating Equipment			567,227	102,101	0	669,328
01.30	Planning, Engineering and Design			10,763,579	2,690,895	0	13,454,474
01.31	Construction Management			4,602,869	1,150,717	0	5,753,586
TOTAL	Yazoo Backwater Pumps 14,000 CFS			98,230,284	17,002,392	0	115,232,676
02	Non-Struc Flood Damage Reduction						
02.01	Lands and Damages			26,973,870	5,313,380	0	32,287,250
02.06	Fish and Wildlife Facilities			5,684,000	568,400	0	6,252,400
02.30	Planning, Engineering and Design			768,000	192,000	0	960,000
TOTAL	Non-Struc Flood Damage Reduction			33,425,870	6,073,780	0	39,499,650
TOTAL	YAZOO BACKWATER PUMP PLAN #4	1.00	EA	131,656,154	23,076,171	0	154,732,325

YAZOO BACKWATER PUMP PLAN #5
FINAL ARRAY OF ALTERNATIVIES
14,000 CFS, AND NONSTRUCTURAL
FLOOD DAMAGE REDUCTION MEASURES

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: PHILLIP G. HEGWOOD

Preparation Date: 02/11/00
Effective Date of Pricing: 10/01/00

Sales Tax: 0.00%

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		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COST
01	Yazoo Backwater Pumps 14,000 CFS						
01.01	Lands and Damages			105,130	26,370	0	131,500
01.02	Relocations			1,516,500	151,650	0	1,668,150
01.09	Channels and Canals			2,505,028	375,754	0	2,880,782
01.11	Levees and Floodwalls			868,048	130,207	0	998,256
01.13	Pumping Plant			76,349,901	12,184,298	0	88,534,199
01.19	Buildings, Grounds, & Utilities			952,002	190,400	0	1,142,403
01.20	Permanent Operating Equipment			567,227	102,101	0	669,328
01.30	Planning, Engineering and Design			10,763,579	2,690,895	0	13,454,474
01.31	Construction Management			4,602,869	1,150,717	0	5,753,586
TOTAL	Yazoo Backwater Pumps 14,000 CFS			98,230,284	17,002,392	0	115,232,676
02	Non-Struc Flood Damage Reduction						
02.01	Lands and Damages			45,473,870	9,828,381	0	55,302,251
02.06	Fish and Wildlife Facilities			8,750,000	875,000	0	9,625,000
02.30	Planning, Engineering and Design			1,148,000	287,000	0	1,435,000
TOTAL	Non-Struc Flood Damage Reduction			55,371,870	10,990,381	0	66,362,251
TOTAL	YAZOO BACKWATER PUMP PLAN #5	1.00	EA	153,602,154	27,992,772	0	181,594,926

YAZOO BACKWATER PUMP PLAN #6
FINAL ARRAY OF ALTERNATIVES
14,000 CFS, AND NONSTRUCTURAL
FLOOD DAMAGE REDUCTION MEASURES

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: PHILLIP G. HEGWOOD

Preparation Date: 02/11/00
Effective Date of Pricing: 10/01/00

Sales Tax: 0.00%

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		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COST
01	Yazoo Backwater Pumps 14,000 CFS						
01.01	Lands and Damages			105,130	26,370	0	131,500
01.02	Relocations			1,516,500	151,650	0	1,668,150
01.09	Channels and Canals			2,505,028	375,754	0	2,880,782
01.11	Levees and Floodwalls			868,048	130,207	0	998,256
01.13	Pumping Plant			76,349,901	12,184,298	0	88,534,199
01.19	Buildings, Grounds, & Utilities			952,002	190,400	0	1,142,403
01.20	Permanent Operating Equipment			567,227	102,101	0	669,328
01.30	Planning, Engineering and Design			10,763,579	2,690,895	0	13,454,474
01.31	Construction Management			4,602,869	1,150,717	0	5,753,586
TOTAL	Yazoo Backwater Pumps 14,000 CFS			98,230,284	17,002,392	0	115,232,676
02	Non-Struc Flood Damage Reduction						
02.01	Lands and Damages			55,237,870	12,159,380	0	67,397,250
02.06	Fish and Wildlife Facilities			10,822,000	1,082,200	0	11,904,200
02.30	Planning, Engineering and Design			1,392,000	348,000	0	1,740,000
TOTAL	Non-Struc Flood Damage Reduction			67,451,870	13,589,580	0	81,041,450
TOTAL	YAZOO BACKWATER PUMP PLAN #6	1.00	EA	165,682,154	30,591,971	0	196,274,125

YAZOO BACKWATER PUMP PLAN #7
FINAL ARRAY OF ALTERNATIVES
14,000 CFS, AND NONSTRUCTURAL
FLOOD DAMAGE REDUCTION MEASURES

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: PHILLIP G. HEGWOOD

Preparation Date: 02/11/00
Effective Date of Pricing: 10/01/00

Sales Tax: 0.00%

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Release 5.30

		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COST
01	Yazoo Backwater Pumps 14,000 CFS						
01.01	Lands and Damages			105,130	26,370	0	131,500
01.02	Relocations			1,516,500	151,650	0	1,668,150
01.09	Channels and Canals			2,505,028	375,754	0	2,880,782
01.11	Levees and Floodwalls			868,048	130,207	0	998,256
01.13	Pumping Plant			76,349,901	12,184,298	0	88,534,199
01.19	Buildings, Grounds, & Utilities			952,002	190,400	0	1,142,403
01.20	Permanent Operating Equipment			567,227	102,101	0	669,328
01.30	Planning, Engineering and Design			10,763,579	2,690,895	0	13,454,474
01.31	Construction Management			4,602,869	1,150,717	0	5,753,586
TOTAL	Yazoo Backwater Pumps 14,000 CFS			98,230,284	17,002,392	0	115,232,676
02	Non-Struc Flood Damage Reduction						
02.01	Lands and Damages			113,672,370	25,110,505	0	138,782,875
02.06	Fish and Wildlife Facilities			14,980,000	1,498,000	0	16,478,000
02.30	Planning, Engineering and Design			3,328,000	832,000	0	4,160,000
TOTAL	Non-Struc Flood Damage Reduction			131,980,370	27,440,505	0	159,420,875
TOTAL	YAZOO BACKWATER PUMP PLAN #7	1.00	EA	230,210,654	44,442,896	0	274,653,550

MCACES
RECOMMENDED PLAN

YAZOO BACKWATER PUMP PLAN #5
FINAL ARRAY OF ALTERNATIVIES
14,000 CFS, AND NONSTRUCTURAL
FLOOD DAMAGE REDUCTION MEASURES

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: PHILLIP G. HEGWOOD

Preparation Date: 02/11/00
Effective Date of Pricing: 10/01/00

Sales Tax: 0.00%

		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COS
01	Yazoo Backwater Pumps 14,000 CFS						
01.01	Lands and Damages			105,130	26,370	0	131,500
01.02	Relocations			1,516,500	151,650	0	1,668,150
01.09	Channels and Canals			2,505,028	375,754	0	2,880,782
01.11	Levees and Floodwalls			868,048	130,207	0	998,256
01.13	Pumping Plant			76,349,901	12,184,298	0	88,534,199
01.19	Buildings, Grounds, & Utilities			952,002	190,400	0	1,142,403
01.20	Permanent Operating Equipment			567,227	102,101	0	669,328
01.30	Planning, Engineering and Design			10,763,579	2,690,895	0	13,454,474
01.31	Construction Management			4,602,869	1,150,717	0	5,753,586
TOTAL	Yazoo Backwater Pumps 14,000 CFS			98,230,284	17,002,392	0	115,232,676
02	Non-Struc Flood Damage Reduction						
02.01	Lands and Damages			45,473,870	9,828,381	0	55,302,251
02.06	Fish and Wildlife Facilities			8,750,000	875,000	0	9,625,000
02.30	Planning, Engineering and Design			1,148,000	287,000	0	1,435,000
TOTAL	Non-Struc Flood Damage Reduction			55,371,870	10,990,381	0	66,362,251
TOTAL	YAZOO BACKWATER PUMP PLAN #5	1.00	EA	153,602,154	27,992,772	0	181,594,926

MCACES
RECOMMENDED PLAN
FULLY FUNDED

YAZOO BACKWATER SELECTED PLAN
FINAL ARRAY OF ALTERNATIVIES
14,000 CFS, AND NONSTRUCTURAL
FLOOD DAMAGE REDUCTION MEASURES

Designed By: USAED, VICKSBURG
Estimated By: COST ENGINEERING BRANCH

Prepared By: PHILLIP G. HEGWOOD

Preparation Date: 02/11/00
Effective Date of Pricing: 10/01/00

Sales Tax: 0.00%

		QUANTY	UOM	CONTRACT COST	CONTINGN	ESCALATN	TOTAL COST
01	Yazoo Backwater Pumps 14,000 CFS						
01.01	Lands and Damages			105,130	26,370	15,483	146,983
01.02	Relocations			1,516,500	151,650	328,626	1,996,776
01.09	Channels and Canals			2,505,028	375,754	567,514	3,448,296
01.11	Levees and Floodwalls			868,048	130,207	196,656	1,194,912
01.13	Pumping Plant			76,349,901	12,184,298	17,441,237	105,975,436
01.19	Buildings, Grounds, & Utilities			952,002	190,400	225,053	1,367,456
01.20	Permanent Operating Equipment			567,227	102,101	131,858	801,185
01.30	Planning, Engineering and Design			10,763,579	2,690,895	1,739,663	15,194,137
01.31	Construction Management			4,602,869	1,150,717	1,516,070	7,269,656
TOTAL	Yazoo Backwater Pumps 14,000 CFS			98,230,284	17,002,392	22,162,161	137,394,837
02	Non-Struc Flood Damage Reduction						
02.01	Lands and Damages			45,473,870	9,828,381	1,913,136	57,215,386
02.06	Fish and Wildlife Facilities			8,750,000	875,000	1,322,475	10,947,475
02.30	Planning, Engineering and Design			1,148,000	287,000	185,546	1,620,546
TOTAL	Non-Struc Flood Damage Reduction			55,371,870	10,990,381	3,421,156	69,783,40
TOTAL	YAZOO BACKWATER SELECTED PLAN	1.00	EA	153,602,154	27,992,772	25,583,317	207,178,243